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800 TRANSPONDER (TYPE 859A)

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SERVICE PARTS MANUAL

SERVICE / PARTS MANUAL

800 TRANSPONDER

Type 859A

This manual contains factory recommended procedures for servicing and maintaining the Cessna 800 Transponder. This manual is divided into seven sections, each section containing the necessary information and a parts breakdown to assist in the overhaul and replacement of parts on each respective Cessna 800 Transponder Unit.

This information is supplemented and kept current by Service Letters and Service News Letters published by the Cessna Aircraft Company. Recommended replacement parts for this system are available from Cessna Dealers Organization.

Cessna Aircraft Company
Wichita, Kansas
October 1973

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Cessna 800 Transponder

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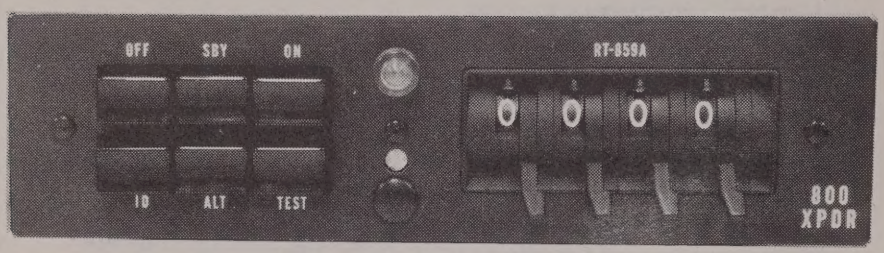


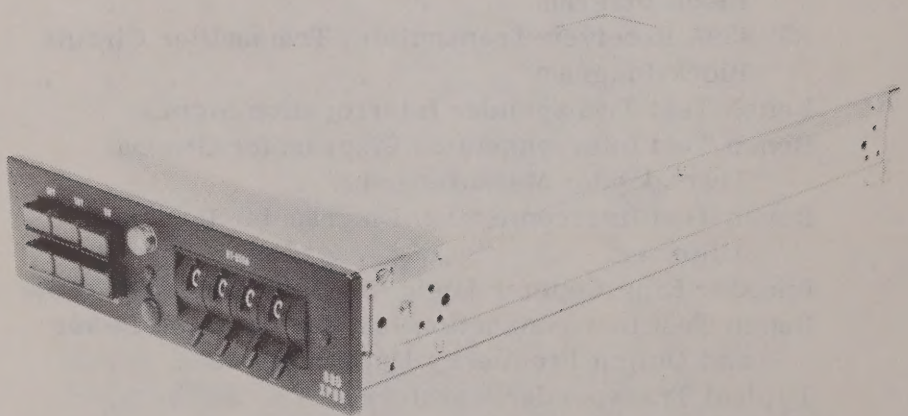


Figure 1-1. Cessna 800 Transponder

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

This instruction book contains installation, operation, maintenance, and parts information for the Cessna 800 Transponder (Type 859A).

1-2. PURPOSE.

The 859A is the airborne component of an Air Traffic Control Radar Beacon System (ATCRBS). The transponder enables the ATC ground controller to "see" and identify the aircraft while in flight at distances beyond the primary radar range.

The 859A consists of a panel-mounted RT-859A Receiver-Transmitter and an externally-mounted A-109A Antenna. The transponder receives interrogating pulse signals on 1030 MHz and transmits coded pulse-train reply signals on 1090 MHz. It is capable of replying to Mode A (aircraft identification) interrogations on any of 4,096 information code selections. When an altitude encoder or digitizer (not part of the 859A Transponder) is installed in the aircraft, the transponder can provide Mode C altitude reporting in 100-foot increments between -1000 and +63,000 feet.

1-3. FCC LICENSING DATA.

Application for an aircraft radio station license for the 859A Transponder must be made on FCC Form 404. In response to Question No. 14 of Form 404, insert:

Manufacturer	Type No.
Aircraft Radio Corporation Boonton, New Jersey, U.S.A.	RT-859A

Complete technical information for the 859A Transponder is on file with the Federal Communications Commission.

1-4. SPECIFICATIONS.

Input Power Requirement:	2 A maximum at 27.5 Vdc
Weight:	3.8 pounds
Altitude Range:	Sea level to maximum aircraft altitude
Operating Frequency:	Receive - 1030 MHz Transmit - 1090 MHz
Modes of Operation:	Mode A and Mode C, selected automatically
Mode C of Reply Code Capability:	With optional altitude encoder, 100-ft increments from -1000 to +63,000 feet
Transmitter Frequency Control:	Tuned-cavity resonator
Receiver Sensitivity:	-72 dBm to -80dBm
Receiver Dynamic Range:	50 dB, minimum
Receiver Selectivity:	Greater than 60 dB attenuation at ±25 MHz
Transmitter Power Output:	250 W, peak (Typical)
Certification:	
RT-859A:	TSO-74c, DO-138 Env. Cat. DAPABBXXXXXX, Class 1A.
Mounting 42280:	TSO-74c, DO-138 Env. Cat. DAPXXXXXXXXX, Class 1A.
A-109A:	TSO-C74b, Env. Cat. JAJXXXXXXXXX, Class 1.

1-5. UNITS AND ACCESSORIES.

The units and accessories supplied as the 859A are listed in Table 1-1.

TABLE 1-1. UNITS AND ACCESSORIES

Quantity	Name	Part Number
1	RT-859A Receiver-Transmitter	42260-0028
1	Mounting	42280
1	A-109A Antenna	41530
1	Connector Kit, consisting of:	42289-0000* 42289-0001+
1	Connector	42104-1023
20	Contacts	42104-2010
3	Contacts	42104-2026
2	Screw	104-0028
3	Washer	13348
2	Nut	8949-0040
1	Retaining ring	28665-0043
1	RF connector (supplied with 42289-0000)	11337
1	RF connector (supplied with 42289-0001)	42634
1	RF connector (supplied with 42289-0000)	42103-0003
1	RF connector (supplied with 42289-0001)	42103-0004

* For use with RG-58/U cable, ARC Part No. 11318; used when antenna cable length does not exceed 8-1/2 feet.

\+ For use with Times T5-50 cable, ARC Part No. 42642; used when antenna cable length exceeds 8-1/2 feet.

1-6. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

Interconnection Cables. Interconnecting cable assemblies are not supplied but are fabricated from individual wires and coaxial cable (not supplied) and the connectors listed in Table 1-1. Either the RG-58/U coaxial cable (ARC Part No. 11318) or the Times T5-50 RF cable (Part No. 42642) can be obtained on special order.

Altitude Encoder. To supply altitude information for the Mode C transponder reply, an altitude encoder or digitizer (not part of the 859A) must be included in the 859A installation. Any unit that supplies the following inputs to the RT-859A may be used.

1. Input voltage limit; The input voltage on any altitude lead shall be between 0.0 and +5.25 volts, with respect to Mode C common.

2. Logic 0 input: Logic 0 input shall be +0.4 volt, maximum, with maximum current flow of 2.7 milliamperes.

3. Logic 1 input: Logic 1 input shall be +3 volts, minimum, with maximum current flow of 40 microamperes.

4. Logic sense: A logic 0 on any altitude input lead will produce a transponder output pulse for its respective position. For any altitude leads not connected, the transponder will assume a logic 1.

1-7. DESCRIPTION OF UNITS.

Receiver-Transmitter. The RT-859A Receiver-Transmitter is a panel-mounted unit that contains all of the transponder circuits. In addition to a receiver, a transmitter, a decoder, and an encoder, an automatic overload control circuit (AOC), a self-test circuit, and a solid-state power supply are also included. A diplexer at the antenna input permits the use of a common antenna for both reception and transmission without external switching.

Except for the selection of Mode C reply pulses (selected automatically by the logic input from a separate altitude encoder), all operating controls for the transponder are located on the front panel of the RT-859A. All electrical connections to the receiver-transmitter are made through two connectors on the back of the unit.

Except for the transmitter power oscillator, all of the transponder circuits use solid-state devices. The transmitter power oscillator uses an electron tube operating in a cavity resonator. The cavity resonator, tuned to 1090 MHz, controls the transmitter output frequency. A reply monitor circuit which includes a panel indicator lamp provides a visual indication of transponder operation.

The receiver uses a superheterodyne circuit fixed-tuned to receive the 1030 MHz interrogation signal. A crystal-controlled local oscillator signal is mixed with the interrogation input to produce the 60 MHz IF frequency. AOC circuits limit the receiver sensitivity when the reply rate exceeds the preset limit or when the transmitter output tube exceeds its duty cycle.

The decoder circuits recognize and decode proper interrogating signals in either Mode A or Mode C. Sidelobe signals or noise pulses are examined and discarded. The encoder circuits assemble the selected reply pulse train for the interrogating mode and apply the reply pulses to the transmitter. Both the decoder and the encoder use logic circuits to process the signals.

The power supply includes a series regulator and a dc-to-dc power converter to convert the aircraft supply voltage to the voltages required for transponder operation. These voltages include a regulated +9.2 volts, +5 volts, -8.2 volts, and +1400 volts.

Antenna. The A-109A Antenna is a quarter-wave UHF antenna encapsulated with foam and sealed in a hard plastic shell. It is terminated with a UG-625A/U connector and is designed to match 50-ohm coaxial line. The antenna is installed on the belly of the aircraft in any location that will not affect the antenna pattern when the aircraft is in flight.

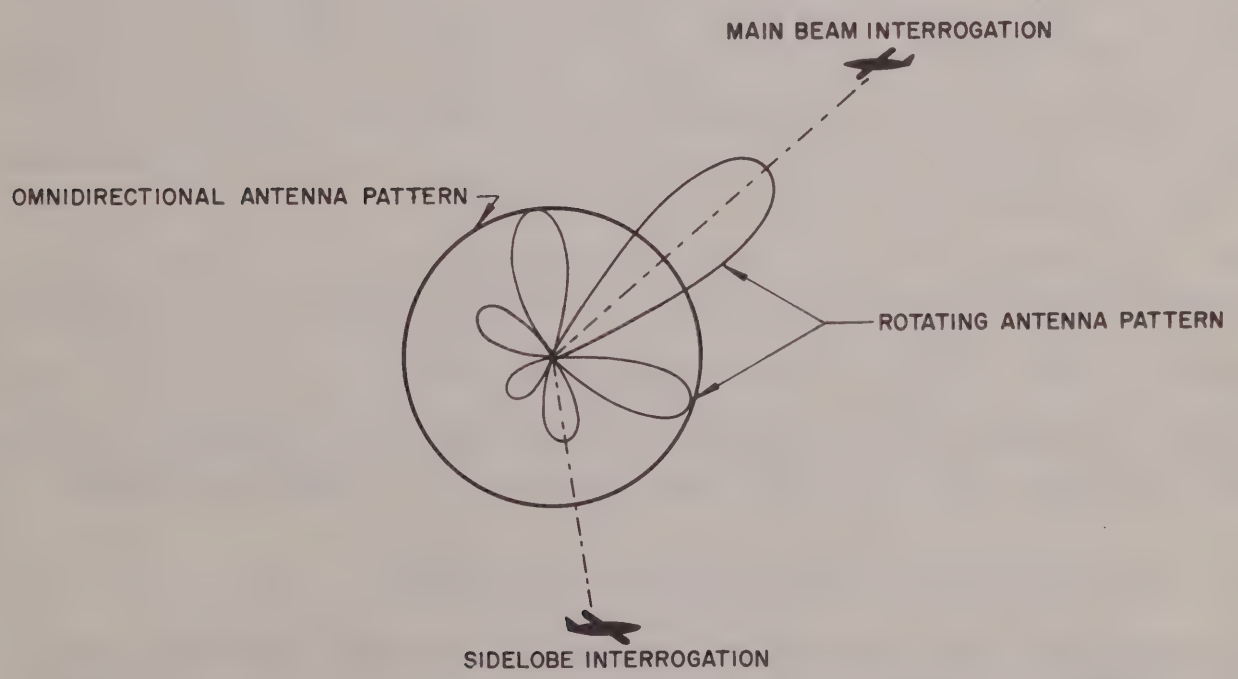


Figure 1-2. Comparison of ATCRBS Ground Station Antenna Patterns

Mounting. Mounting Assembly 42290-0014 or 42290-0028 is used to panel-mount the RT-859A and to make electrical connections to the unit. The electrical connections are made through a 23-pin connector and an antenna connector supplied in a connector kit and mounted on the rear of the mounting assembly at the time of installation. A resistor mounted on the rear of the mounting is used to drop the +28-volt input from the aircraft supply to the +14 volts required for operation of the RT-859A power supply.

1-8. PRINCIPLES OF ATCRBS.

The ATCRBS is a secondary surveillance radar system used by air traffic control facilities to aid in the position identification of aircraft in flight. It includes a ground-based interrogator-receiver, an airborne transponder, and air traffic control radar display equipment.

The ground-based interrogator transmits an interrogation pulse group at 1030 MHz which consists of pulses designated P1, P2, and P3. (See Figure 1-2.) Pulses P1 and P3 are transmitted from the main beam of a rotating antenna; the time spacing between pulses determines the mode of operation (8 USEC for Mode A aircraft identification, and 21 USEC for Mode C altitude reporting). P2, which follows P1 by 2 USEC, is transmitted from an omnidirectional antenna with a signal strength considerably less than the main beam of the rotating antenna. However, unless the aircraft is in the main beam of the rotating antenna at the time the ground interrogation is received, P2 is received at the same or greater signal strength than P1 and P3, and the interrogation is not recognized by the transponder. Thus transponder replies to sidelobes of the interrogating signal are suppressed, and the replies are confined to the relatively narrow segment of the radar display scan when the aircraft is in the main beam of the antenna and both P1 and P3 are stronger than P2.

When a valid interrogation is received by the transponder, the mode of interrogation is determined and the coded reply signal is transmitted. The ground-based receiver decodes the reply and the reply is displayed on a radar scope. Calculation of the round-trip transit time of the interrogation and the reply determines the range of the aircraft, while direction of the main beam of the rotating antenna, during reply, determines the azimuth. The arrangement of pulses in the multiple pulse reply provides individual identity and altitude information pertaining to the responding aircraft.

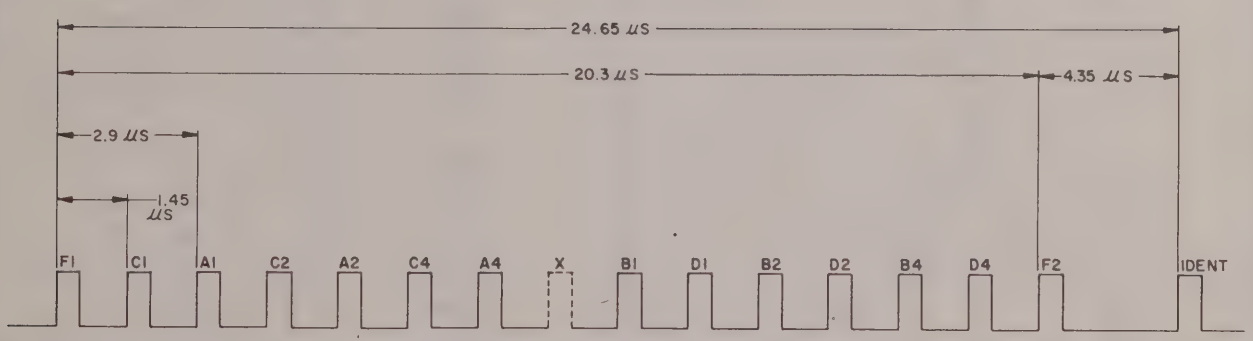
1-9. REPLY CODE PULSES IDENTIFICATION AND SPACING.

The transponder reply consists of two framing and up to twelve information pulses. The presence or absence of the twelve pulses is used to convey flight information to the ground controller. Each of the twelve pulses has a fixed nomenclature and time position in the reply pulse-train signal. The pulses are divided into four groups of three pulses, identified as the A, B, C, and D groups. Each pulse within a group is assigned an identification number which fixes its position in the reply pulse-train.

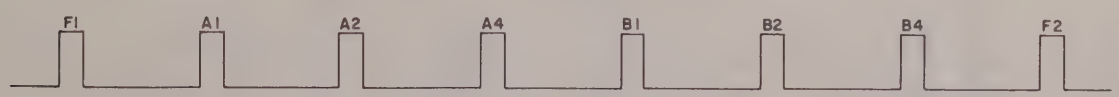
The numbers used (1, 2, and 4) form a binary code in which their various sums give the maximum number of combinations without repetition, for any three numbers. Any digit from 0 to 7 can be obtained within a pulse group; thus, any number between 0000 and 7777 using these digits can be selected for the transponder reply.

The digits of the assigned code number indicate the code groups to be used and the pulse coding within the group. The assigned code is a four-digit number (any of 4096) in which the "thousands" digit designates the A group, the "hundreds" digit the B group, the "tens" digit the C group, and the "units" digit the D group. Information pulses present in assigned reply codes are shown in Table 1-2.

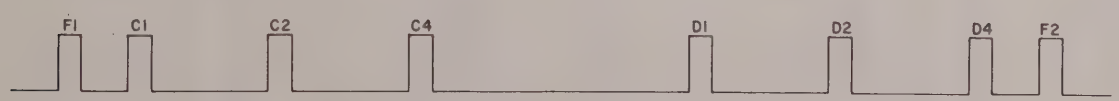
The A and B pulse groups are spaced at 1.9 USEC intervals between the framing pulses and the C and D groups are interspaced at 1.45 USEC intervals between the A and B pulses. Table 1-3 lists the pulse number, pulse nomenclature, and microsecond position from the first framing pulse of the 16 pulses which comprise the reply-pulse train. Each discrete pulse will always occur at the same time interval with relation to the leading edge of pulse F1, regardless of the number of pulses in the selected reply code. Figure 1-3 illustrates pulse spacing for typical pulse trains.



A. PULSE SPACING OF THE SIXTEEN REPLY PULSES, REPLY CODE 7777 WITH IDENT PULSE



B. PULSE SPACING, REPLY CODE 7700 (77)



C. PULSE SPACING, REPLY CODE 0077

TP 4281

Figure 1-3. Reply Code Pulse Spacing

TABLE 1-2. ATCRBS REPLY CODE NUMBERS

4095-Code No.	Information Pulses Present	4095-Code No.	Information Pulses Present
0000	None	3000	A1, A2
0001	D1	3100	A1, A2, B1
0002	D2	3200	A1, A2, B2
0003	D1, D2	3300	A1, A2, B1, B2
0004	D4	3400	A1, A2, B4
0005	D1, D4	3500	A1, A2, B1, B4
0006	D2, D4	3600	A1, A2, B2, B4
0007	D1, D2, D4	3700	A1, A2, B1, B2, B4
0010	C1	4000	A4
0020	C2	4100	A4, B1
0030	C1, C2	4200	A4, B2
0040	C4	4300	A4, B1, B2
0050	C1, C4	4400	A4, B4
0060	C2, C4	4500	A4, B1, B4
0070	C1, C2, C4	4600	A4, B2, B4
		4700	A4, B1, B2, B4
0100	B1	5000	A1, A4
0200	B2	5100	A1, A4, B1
0300	B1, B2	5200	A1, A4, B2
0400	B4	5300	A1, A4, B1, B2
0500	B1, B4	5400	A1, A4, B4
0600	B2, B4	5600	A1, A4, B2, B4
		5700	A1, A4, B1, B2, B4
1000	A1	6000	A2, A4
1100	A1, B1	6100	A2, A4, B1
1200	A1, B2	6200	A2, A4, B2
1300	A1, B1, B2	6300	A2, A4, B1, B2
1400	A1, B4	6400	A2, A4, B4
1500	A1, B1, B4	6500	A2, A4, B1, B4
1600	A1, B2, B4	6600	A2, A4, B2, B4
1700	A1, B1, B2, B4	6700	A2, A4, B1, B2, B4
2000	A2	7000	A1, A2, A4
2100	A2, B1	7100	A1, A2, A4, B1
2200	A2, B2	7200	A1, A2, A4, B2
2300	A2, B1, B2	7300	A1, A2, A4, B1, B2

TABLE 1-2. ATCRBS REPLY CODE NUMBERS (CONTINUED)

4095-Code No.	Information Pulses Present	4095-Code No.	Information Pulses Present
2400	A2, B4	7400	A1, A2, A4, B4
2500	A2, B1, B4	7500	A1, A2, A4, B1, B4
2600	A2, B2, B4	7600	A1, A2, A4, B4
2700	A2, B1, B2, B4	7700	A1, A2, A4, B1, B2, B4

EXAMPLES

Code No.	
1100	A1, B1
0011	C1, D1
3600	A1, A2, B2, B4
0535	B1, B4, C1, C2, D2, D4
0606	B2, B4, D2, D4
6060	A2, A4, C2, C4
7461	A1, A2, A4, B4, C2, C4, D1
7700	A1, A2, A4, B1, B2, B4
0077	C1, C2, C4, D1, D2, D4
7777	A1, A2, A4, B1, B2, B4, C1, C2, C4, D1, D2, D4

TABLE 1-3. REPLY PULSE POSITIONS

Pulse Number	Pulse Nomenclature	Microsecond Position From First Framing Pulse
1	First Framing Pulse	0
2	C1	1.45
3	A1	2.9
4	C2	4.35
5	A2	5.8
6	C4	7.25
7	A4	8.7
8	X*	10.75
9	B1	11.6
10	D1	13.05
11	B2	14.5
12	D2	15.95
13	B4	17.4
14	D4	18.85
15	Second Framing Pulse	20.3
16	Special Identification Pulse	24.65

*"X" pulse has no function in the general aviation transponder.

SECTION 2

INSTALLATION

2-1. UNPACKING.

Carefully unpack the transponder set. Inspect the units and accessories for damage and check the items against the packing slip to be sure all the items have been received and removed from the packing case.

2-2. PREINSTALLATION TEST.

If desired, before the transponder is installed in the aircraft, the operation of the set may be checked on the bench using the self-test feature and the REPLY monitor lamp. To test the transponder, proceed as follows:

Step 1. Interconnect the transponder as shown in Figure 2-5.

CAUTION: TO PREVENT DAMAGE TO THE TRANSMITTER OUTPUT CIRCUIT, A 50-OHM LOAD MUST BE CONNECTED TO ANTENNA CONNECTOR A1J1 DURING ALL TRANSPONDER OPERATION. IF THE A-109A ANTENNA IS USED AS A TRANSMITTER LOAD DURING TESTING, THE ANTENNA MUST OPERATE AGAINST A GROUND PLANE AT LEAST 3 FEET SQUARE.

Step 2. Push in ON button on receiver-transmitter panel and wait 30 seconds for equipment warmup.

Step 3. Depress TEST button and hold it down. REPLY lamp should light brightly as long as the TEST button is depressed. Release test button.

Step 4. Push in OFF button to turn transponder off.

2-3. INSTALLATION REQUIREMENTS.

The location and installation of the transponder set will depend on the aircraft in which the set is installed; however, the following general requirements apply to all aircraft.

Step 1. Refer to the installation diagrams in this section. Check that the proposed installation area can accommodate the units to be installed.

Step 2. Locate the receiver-transmitter within convenient view and reach of the operator, in an area where it will be accessible for inspection and maintenance, but not subject to excessive heat or vibration.

Step 3. Since both the interrogator and the transponder use line-of-sight transmission, the position of the antenna can affect the overall performance of the transponder. Locate the antenna on the belly of the aircraft at or near the lowest point of the fuselage when the aircraft is in the normal flight attitude. Choose an area which is at least 1-1/2 feet from other antennas or projections, so that the antenna will not be shielded from the ground station at any heading.

Step 4. If the required length of antenna cable between the receiver-transmitter and the antenna is 8-1/2 feet or less, use the coaxial connectors supplied in the connector kit 42289-0000 and RG-58/U coaxial cable. If the required length of antenna cable is greater than 8-1/2 feet, use the coaxial connectors supplied in connector kit 42289-0001 and Times T5-50 RF cable. The length of the antenna cable must not exceed 18 feet; use of a cable longer than specified will result in decreased transponder range.

CAUTION: USE CARE IN PREPARING COAXIAL CABLES AND CONNECTORS. SERIOUS MISMATCHES CAN BE INTRODUCED BY IMPROPER ASSEMBLY TECHNIQUES AND THE EXCESSIVE USE OF ADAPTER AND FITTINGS.

2-4. CABLE FABRICATION AND CONNECTOR INSTALLATION.

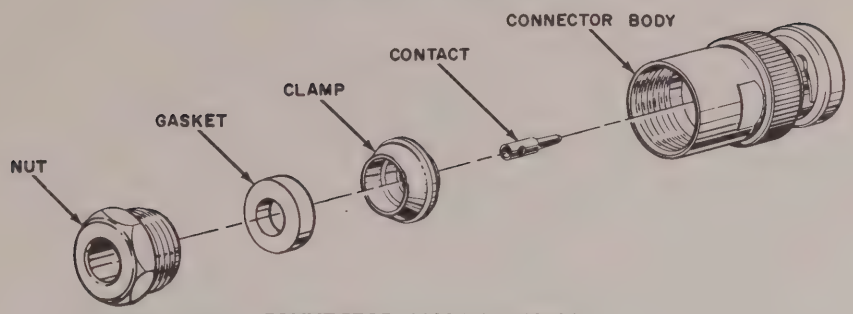
General. The interconnecting cables for the 859A are fabricated from individual wires and coaxial cable (not supplied) and the connectors supplied in connector kit 42289-0000 or 42289-0001. The cables are fabricated at the time of installation to meet the requirements of the individual aircraft. Prepare the cables and install the connectors as follows:

Connector 42103-0003 or 42103-0004.

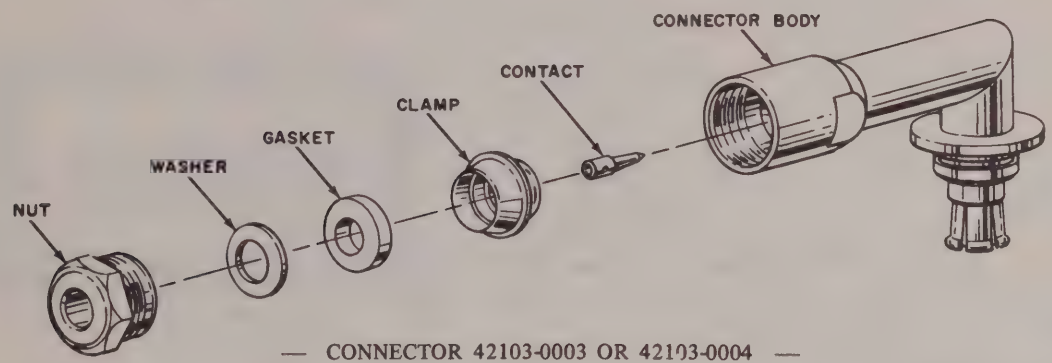
Step 1. Using the appropriate type of coaxial cable and connector 42103-0003 or 42103-0004, fabricate the antenna cable as shown in Figure 2-1.

Step 2. Position the three washers supplied with connector kit against connector flange. (See Figure 2-2.)

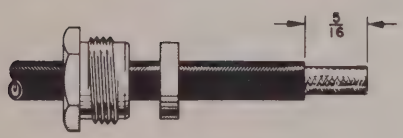
Step 3. Position connector in hole on mounting and secure it in place with retaining ring supplied with kit.



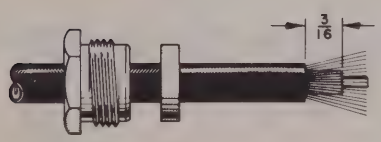
— CONNECTOR 11337 OR 42634 —



— CONNECTOR 42103-0003 OR 42103-0004 —

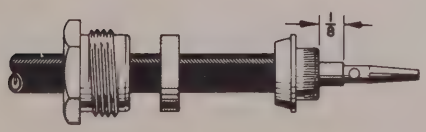


PLACE NUT, WASHER (AS APPLICABLE), AND GASKET OVER CABLE AND TRIM JACKET TO DIMENSION SHOWN. UNGROOVED FACE OF GASKET MUST BE TOWARD NUT.

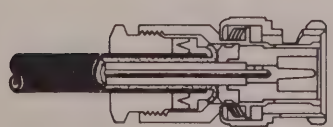


COMB OUT BRAID AND CUT CABLE DIELECTRIC TO DIMENSION SHOWN, BEING CAREFUL NOT TO NICK CENTER CONDUCTOR. TIN CENTER CONDUCTOR.

PULL BRAID WIRES FORWARD AND TAPER TOWARD CENTER CONDUCTOR. PLACE CLAMP OVER BRAID AND PUSH AGAINST CABLE JACKET.

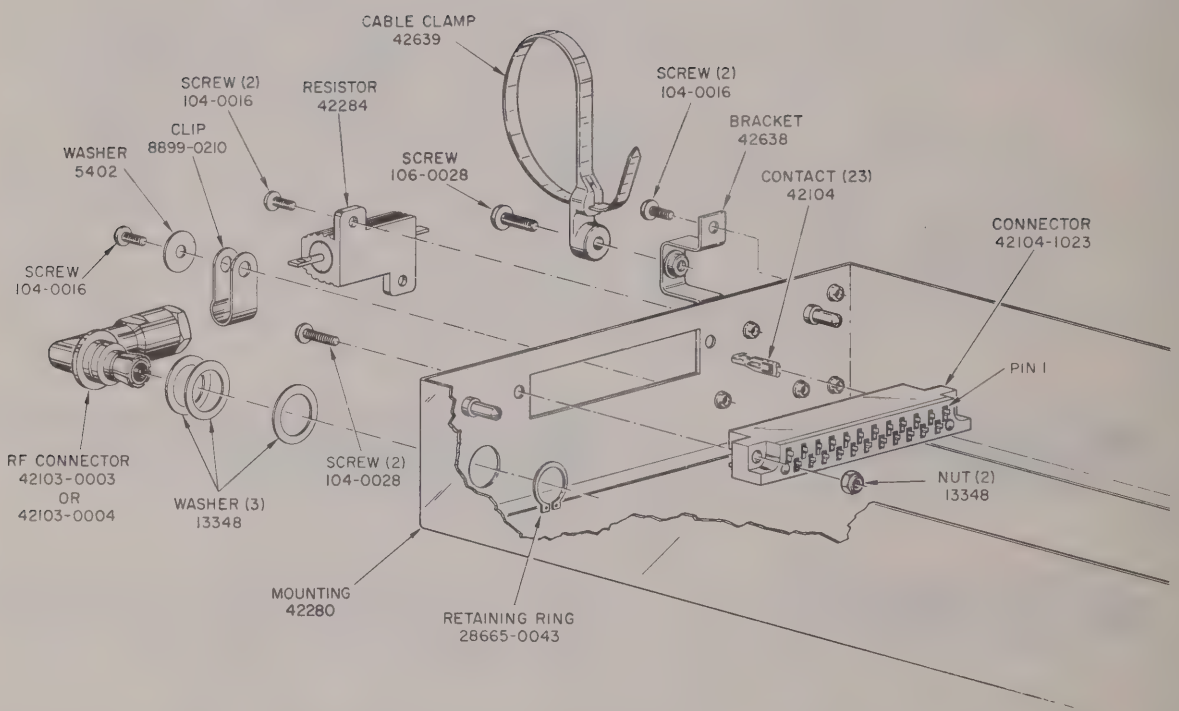


FOLD BACK BRAID WIRES AS SHOWN, TRIM TO PROPER LENGTH, AND FORM OVER CLAMP AS SHOWN. SOLDER CONTACT TO CENTER CONDUCTOR.



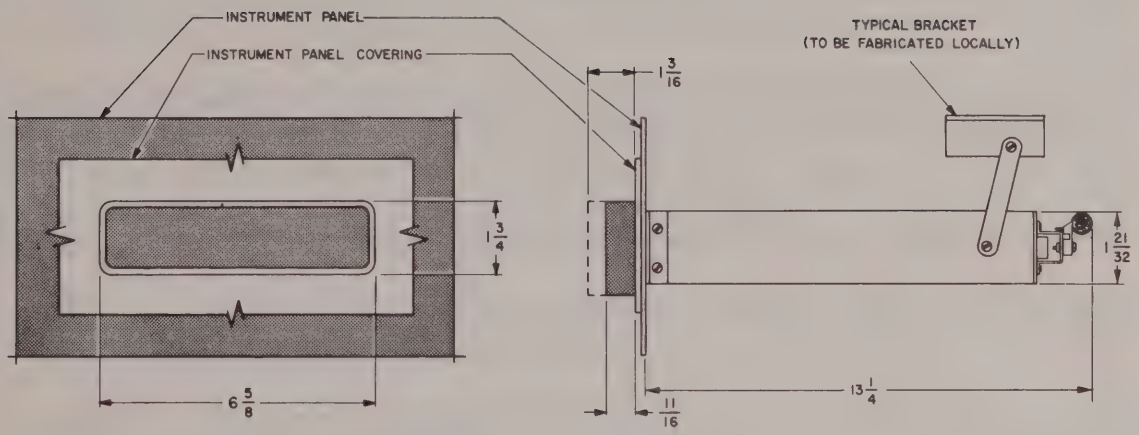
INSERT CABLE AND PARTS INTO CONNECTOR BODY. MAKE SURE SHARP EDGE OF CLAMP SEATS PROPERLY IN GASKET. TIGHTEN NUT.

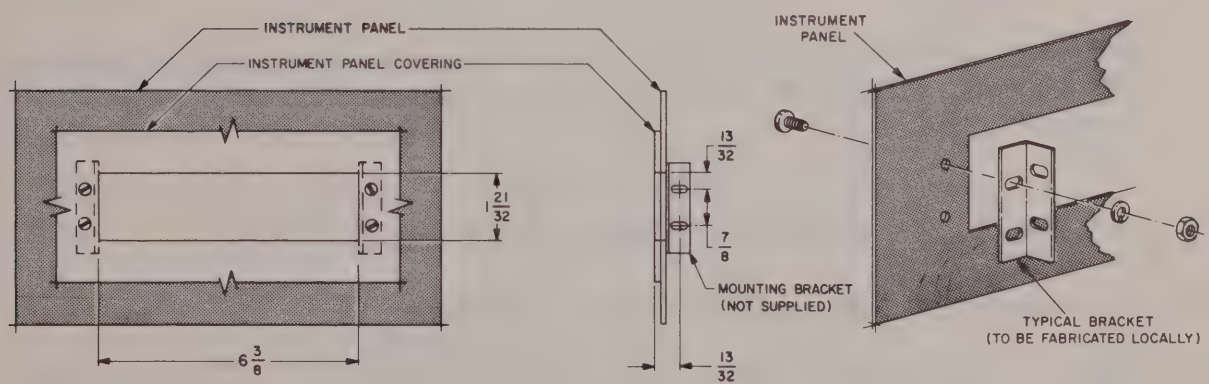
Figure 2-1. Fabrication of Antenna Cable Assembly TP5477



TP 5527

Figure 2-2. Mounting 42280, Exploded View





NOTES:

1. DIMENSIONS ARE IN INCHES.
2. WEIGHT (INCLUDING MOUNTING): 3.5 POUNDS.

Figure 2-3. RT-859A Receiver-Transmitter and Mount

TP 5385

Step 4. Pass antenna cable through nylon clip on mounting, and tighten clip.

Step 5. Terminate other end of coaxial cable at antenna with connector 11337 or 42634, as supplied.

Connector 42104-1023.

Step 1. Cut wiring of sufficient length; use color-coded wire or tag each end of the wire to simplify interconnection. (See Figure 2-5.)

Step 2. Crimp the connector contacts to the wires. Note that two sizes of contacts are supplied. Three contacts, Part No. 42104-2026, are for No. 18 AWG wire; 20 contacts, Part No. 42104-2010, are for No. 20, 22, or 24 AWG wire. The three No. 18 AWG contacts are used in terminals 1, 12, and 22 of connector 42104-1023; the other 20 contacts are used in the remaining terminals.

Step 3. Insert the contacts and wires into the connector terminals. No portion of the contact or stripped portion of the wire should be exposed.

Step 4. Pass wires through opening in mounting, and position connector as shown in Figure 2-2. Secure connector to the mounting assembly with the screws and nuts supplied with the connector kit. After the screws have been tightened, back them off 1-1/2 turns so that the connector "floats" in the mounting.

Step 5. Bend cable to the right and position it in cable clamp on mounting. Allow enough slack in the cable so that the connector "floats" freely, then tighten clamp.

2-5. INSTALLATION OF RECEIVER-TRANSMITTER AND MOUNTING.

Install the receiver-transmitter and mounting as follows:

Step 1. If a knockout panel and mounting flanges are not provided on the aircraft instrument panel, cut the required opening in the panel and fabricate two mounting brackets for the front of the mounting assembly, as shown in Figure 2-3. Brackets (or flanges) must be clean, bare metal for proper grounding of the transponder. Drill holes and attach the brackets to the rear of the instrument panel with suitable hardware.

Step 2. Drill and countersink holes in flanges or brackets to mate with two holes in each side near front of mounting.

Step 3. Fabricate two brackets for rear of mounting (see Figure 2-4) and attach to each hole in side near rear of mounting.

Step 4. Install mounting behind panel and secure front and rear of mounting with 6-32 screws, lockwashers, and nuts.

Step 5. Slide receiver-transmitter firmly into mounting to engage connectors. Secure unit by rotating recessed locking screw near center of lower edge of front panel.

2-6. INSTALLATION OF ANTENNA.

The installation of the antenna can affect the overall performance of the transponder. Refer to the installation requirements in paragraph 2-3, and install the antenna as follows:

Step 1. Drill five holes in the mounting surface as shown. (See Figure 2-4.)

Step 2. Remove paint and clean surfaces around mounting holes to ensure proper grounding of antenna.

Step 3. Obtain four 8-32 screws and nuts (not supplied) suitable for mounting the antenna. Install the four internal-tooth lockwashers (supplied with antenna) under the heads of the four screws.

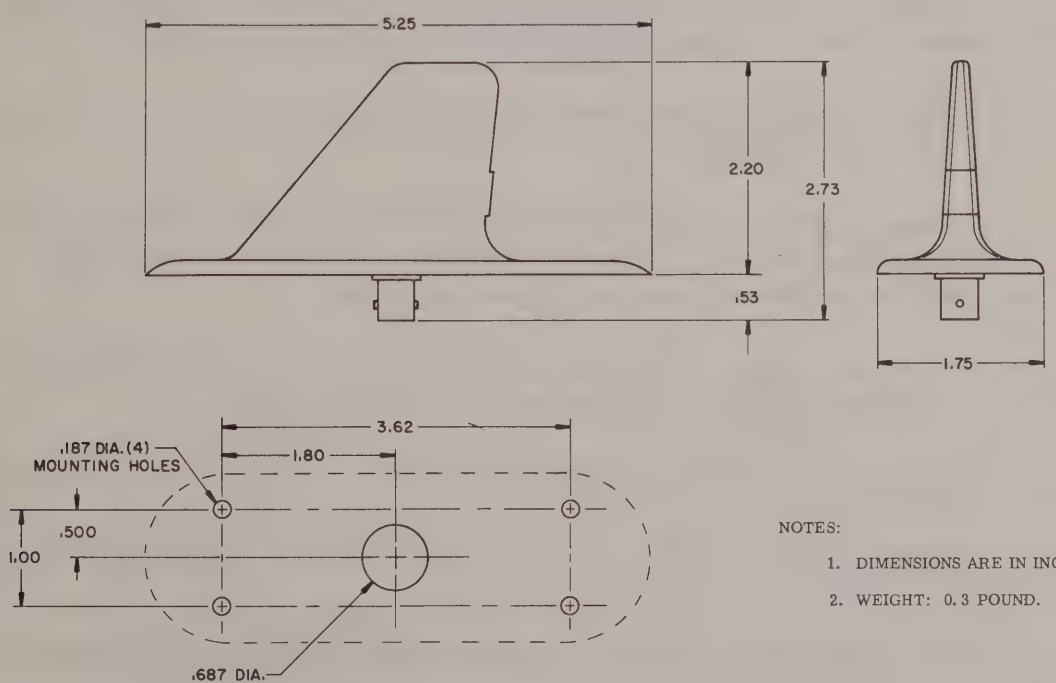


Figure 2-4. A-109A Antenna, Installation Dimensions TP 5131

Step 4. Install the neoprene cork mounting gasket (supplied with antenna) between the antenna and the aircraft skin.

Step 5. Insert the four 8-32 screws (Step 3) through the mounting holes in the antenna and the mounting surface, and secure the antenna with the four 8-32 nuts.

Step 6. Measure the VSWR of the antenna and antenna cable (refer to paragraph 2-8) to make sure the antenna installation provides the proper loading for the transmitter.

2-7. INTERCONNECTION OF UNITS.

An interconnection diagram for the 859A Transponder is shown in Figure 2-5.

2-8. VSWR MEASUREMENT OF AIRCRAFT ANTENNA INSTALLATION.

To ensure proper loading for transponder operation, the VSWR of the A-109A Antenna and the coaxial antenna cable installed in the aircraft should be measured as follows:

Step 1. With one end of coaxial antenna cable connected to antenna, connect free end of cable to Hewlett-Packard Model 776D Directional Coupler.

NOTE: Equivalent test equipment may be substituted for any specified in this procedure.

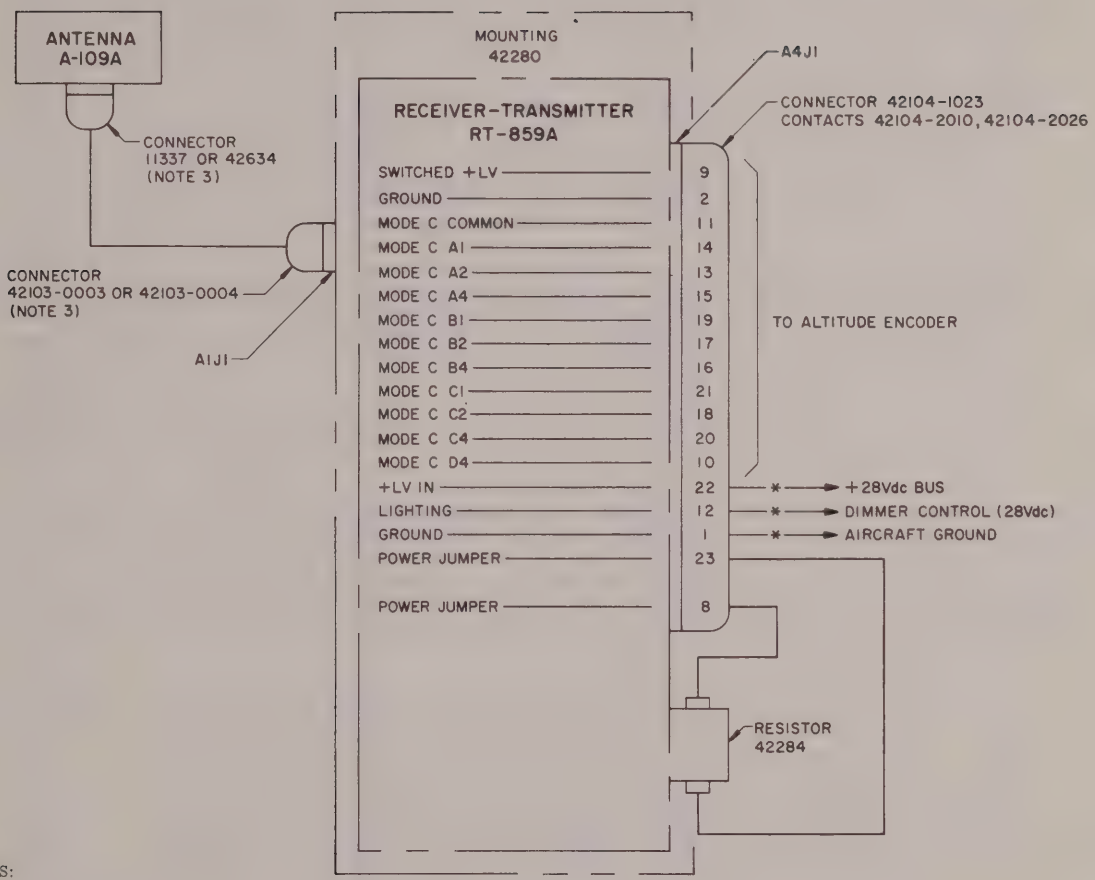
Step 2. Connect output of Hewlett-Packard Model 612A Signal Generator to other end of directional coupler. Connect Boonton Electronics Model 91DA RF Voltmeter to 776D side-port nearest signal generator.

Step 3. Turn on and warm up test equipment. Adjust 612A for 1090-MHz output at level which provides a convenient reference on 91DA.

Step 4. Record 91DA reading as "incident" voltage.

Step 5. Reconnect 91DA to 776D side-port nearest antenna (load). Record 91DA reading as "reflected" voltage.

Step 6. Observe difference between "incident" and "reflected" voltages in dB.



NOTES:

1. FOR PROPER GROUNDING, AIRCRAFT SURFACES TO WHICH UNITS ARE ATTACHED MUST BE CLEAN, BARE METAL.
2. ALL WIRES ARE STRANDED COPPER. UNMARKED WIRES ARE NO. 22 AWG. WIRES MARKED WITH ASTERISK (*) ARE NO. 18 AWG.
3. CONNECTORS 11337 AND 42103-0003 ARE SUPPLIED FOR USE WITH RG-58/U COAXIAL CABLE; LENGTH OF CABLE MUST NOT EXCEED 8-1/2 FEET. CONNECTORS 42634 AND 42103-0004 ARE SUPPLIED FOR USE WITH TIMES T5-50 RF CABLE; LENGTH OF CABLE MUST NOT EXCEED 18 FEET.

Figure 2-5. Cessna 800 Transponder Interconnection Diagram TP 5511

TABLE 2-1. VOLTAGE RATIO AND VSWR RELATIONSHIP

Voltage Ratio (dB)	VSWR	Voltage Ratio (dB)	VSWR
1	17.41	17	1.33
1.2	14.50	18	1.29
1.4	12.43	19	1.24
1.6	10.90	20	1.22
1.8	9.66	21	1.194
2	8.73	22	1.170
2.2	7.49	23	1.153
2.4	7.29	24	1.136
2.6	6.73	25	1.120
2.8	6.26	26	1.105
3	5.85	27	1.093
3.5	5.03	28	1.083
4	4.42	29	1.074
4.5	3.95	30	1.066
5	3.57	31	1.058
5.5	3.26	32	1.051
6	3.01	33	1.046
6.5	2.80	34	1.041
7	2.62	35	1.036
7.5	2.46	36	1.032
8	2.32	37	1.029
8.5	2.20	38	1.027
9	2.10	39	1.023
9.5	2.01	40	1.020
10	1.92	42	1.016
11	1.79	44	1.013
12	1.67	46	1.010
13	1.58	48	1.008
14	1.50	50	1.006
15	1.43	55	1.004
16	1.37	60	1.002

Step 7. Refer to Table 2-1 to determine VSWR of installation (for example, if voltage ratio is 18 dB, VSWR is 1.29). If VSWR of installation exceeds 1.5, to determine defective item, measure antenna and antenna cable VSWR separately, as follows:

a. Disconnect coaxial antenna cable from antenna and from directional coupler. Connect 776D directly to antenna.

b. Repeat Steps 2 through 7. VSWR of antenna should be 1.5 or less.

c. Disconnect antenna, and reconnect 776D to one end of coaxial antenna cable. Connect known 50-ohm load (such as Empire Devices Models AT-50 and AT-57 Attenuators, combined) to other end of antenna cable.

d. Repeat Steps 2 through 7. VSWR of cable and load should be same as VSWR of load (1.1 or less with AT-50 and AT-57).

2-9. POSTINSTALLATION CHECKS.

General. No postinstallation adjustments of the 859A are required; however, postinstallation checks should be performed to verify operation. Operation of the transponder can be checked on the ground using the self-test signal (paragraph 2-2). A flight test should always be performed before considering the equipment operational.

CAUTION: TO PREVENT SERIOUS DAMAGE TO THE TRANSMITTER POWER OUTPUT CIRCUIT, MAKE SURE A PROPERLY MOUNTED A-109A ANTENNA IS CONNECTED TO THE RT-359A ANTENNA CONNECTOR BEFORE CHECKING THE TRANSPONDER WITH THE SELF-TEST SIGNAL, OR BEFORE OPERATING THE TRANSPONDER DURING FLIGHT.

Flight Check. Although the transponder provides visual indication of operation, the flight check should be coordinated with the local air traffic controller. The controller will specify the Mode A reply code to be used and call for the transmission of the IDENT pulse at the appropriate time. The reply lamp should light each time the transponder replies to an interrogation.

SECTION 3

OPERATION

3-1. OPERATING CONTROLS.

Operating controls for the transponder are located on the front panel of the receiver-transmitter and are illustrated in Figure 3-1. The functions of the controls are as follows:

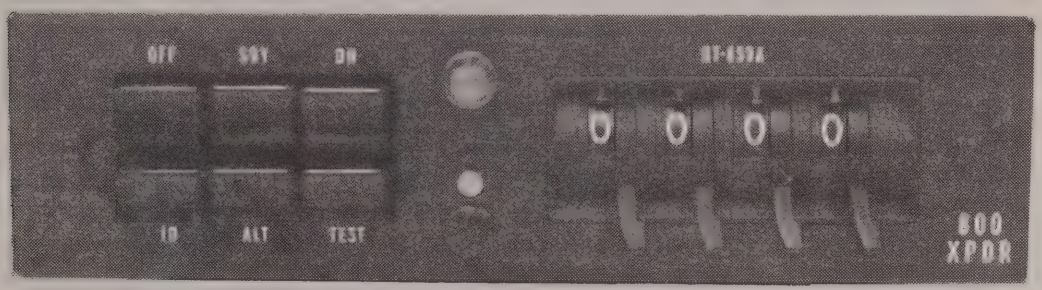


Figure 3-1. Operating Controls

1. OFF - When pushed in, disconnects primary power, except to panel lamps. (Primary power is connected and OFF button automatically released when either SBY or ON button is pushed in.)

2. SBY - When pushed in, primary power is connected but only for transponder warm-up or standby condition (transmitter circuit is disabled).

3. ON - When pushed in, all required operating power is connected, enabling transponder to transmit Mode A reply pulses.

NOTE: OFF, SBY, and ON buttons are interlocked. Button must be fully depressed to activate desired function; partial depression will release all buttons and automatically place transponder in standby condition.

4. ALT - With ON button depressed, when ALT button is pushed in, transponder is enabled to transmit Mode C altitude information pulses, which are selected automatically by the interrogating signal. To release ALT button, push button in again.

5. ID - (Momentary-on switch). When pushed in and released, special pulse identifier is transmitted with transponder reply for identification of aircraft on ground controller's display.

6. TEST - (Momentary-on switch). When pushed in and held, transponder generates a self-interrogating signal to check transponder operation. (REPLY LAMP glows steadily, with full brightness, during test.)

7. REPLY LAMP - Provides visual indication of transponder replies, identifier pulse, and self-test. During normal operation, lamp flashes when reply pulses are transmitted; for identifier pulse, lamp glows steadily for duration of pulse transmission; and during self-test, lamp glows steadily and at maximum brightness. (Except during the self-test, a photoconductive cell automatically adjusts the lamp intensity with relation to the ambient light conditions.)

8. REPLY-CODE SELECTOR SWITCHES - Select assigned Mode A reply code.

9. REPLY-CODE INDICATORS - Display selected Mode A reply code.

3-2. OPERATING PROCEDURES.

Step 1. Using the four Reply-Code Selector Switches 8, select the assigned code.

NOTE: Check current copy of Airman's Information Manual (AIM, Part I) for the use of proper, restricted, and prohibited reply codes.

Step 2. When taxiing for takeoff (or after landing), push in SBY button 2 to prevent undesirable clutter on local radar displays.

Step 3. When airborne, for Mode A transponder operation, push in ON button 3.

Step 4. For altitude reporting, with ON 3 pushed in, push in ALT button 4. When directed by ground controller to "stop altitude squawk," push in ALT button again to release button and discontinue altitude reporting.

NOTE: During ON or ON-ALT operation, REPLY LAMP flashes to indicate that transponder is replying to interrogations, which are normally received at 10- to 15-second intervals. Lamp flashes occurring within this interval may be due to noise, another interrogation, or sidelobes from interrogators without sidelobe suppression.

Step 5. When instructed by ground controller to "squawk IDENT," push in and release ID button 5. (REPLY LAMP will glow steadily, indicating aircraft identification operation.)

CAUTION: TO PREVENT INTERRUPTION OF NORMAL TRANSPONDER OPERATION, RELEASE ID BUTTON IMMEDIATELY AFTER PUSHING IT IN. (A MEMORY CIRCUIT IN THE TRANSPONDER HOLDS THE IDENT REPLY FOR THE INTERVAL REQUIRED TO ENSURE AT LEAST ONE RADAR SWEEP.)

3-3. SELF-TEST OPERATION.

The self-test feature built into the transponder provides a convenient preflight or airborne check of the transponder's Mode A operation. With transponder ON, push in and hold TEST pushbutton; if transponder operation is normal, REPLY LAMP 7 will glow steadily and with maximum brightness.

SECTION 4

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

This section describes the principles of operation of the 859A ATC Transponder. An overall functional description is followed by a detailed description of the major circuits. Refer to paragraphs 1-8 and 1-9 for a discussion of the principles of operation of the ATCRBS and the reply code pulse identification and spacing.

4-2. OVERALL FUNCTIONAL DESCRIPTION.

Power Distribution. A dropping resistor located on the rear of Mounting 42280 provides the required 14-volt input for the power supply. Power to the set is controlled by pushbutton switch assembly A5S1 on the front panel of the RT-859A. When either the SBY or ON button is pushed in, the input voltage is applied through fuse A4F1 to the power circuits in assembly A4. A voltage regulator and a dc-to-dc converter are used to convert the 14 volts to the voltages required for operation. The voltage regulator circuit (A4Q29 - Q32) produces a regulated +9.2-volt output which is used in the receiver circuits. A portion of the +9.2-volt output is dropped to +8.2 volts, +5 volts, and +3.6 volts for use in the coder and transmitter circuits.

The dc-to-dc converter (A4Q33, A4Q34, and A4T1) produces the +1400 volts required for the transmitter output circuit. It also produces a -8.2-volt output which is used in the IDENT timer, the REPLY lamp driver, the encoder clock, and the modulator multivibrator circuits.

Signal Distribution. (See Figure 4-1). When a 1030-MHz interrogation signal is received at the transponder antenna, the signal is applied through the lowpass filter and diplexer to the receiver circuits of the receiver-transmitter. The receiver uses a superheterodyne circuit to convert the 1030-MHz input signal to a 60-MHz IF signal which is amplified and detected for the video signal. The detected video signal is amplified and applied to a pulse width discriminator circuit where the pulses are examined to determine if the signal is from a normal interrogation. The signal is then applied to a sidelobe suppression (SLS) circuit which reduces the receiver sensitivity for approximately 8 USEC after the first pulse of a signal appears to distinguish between valid mainlobe interrogations and sidelobe interrogations. The video signal is further amplified and applied to a buffer gate circuit in the decoder.

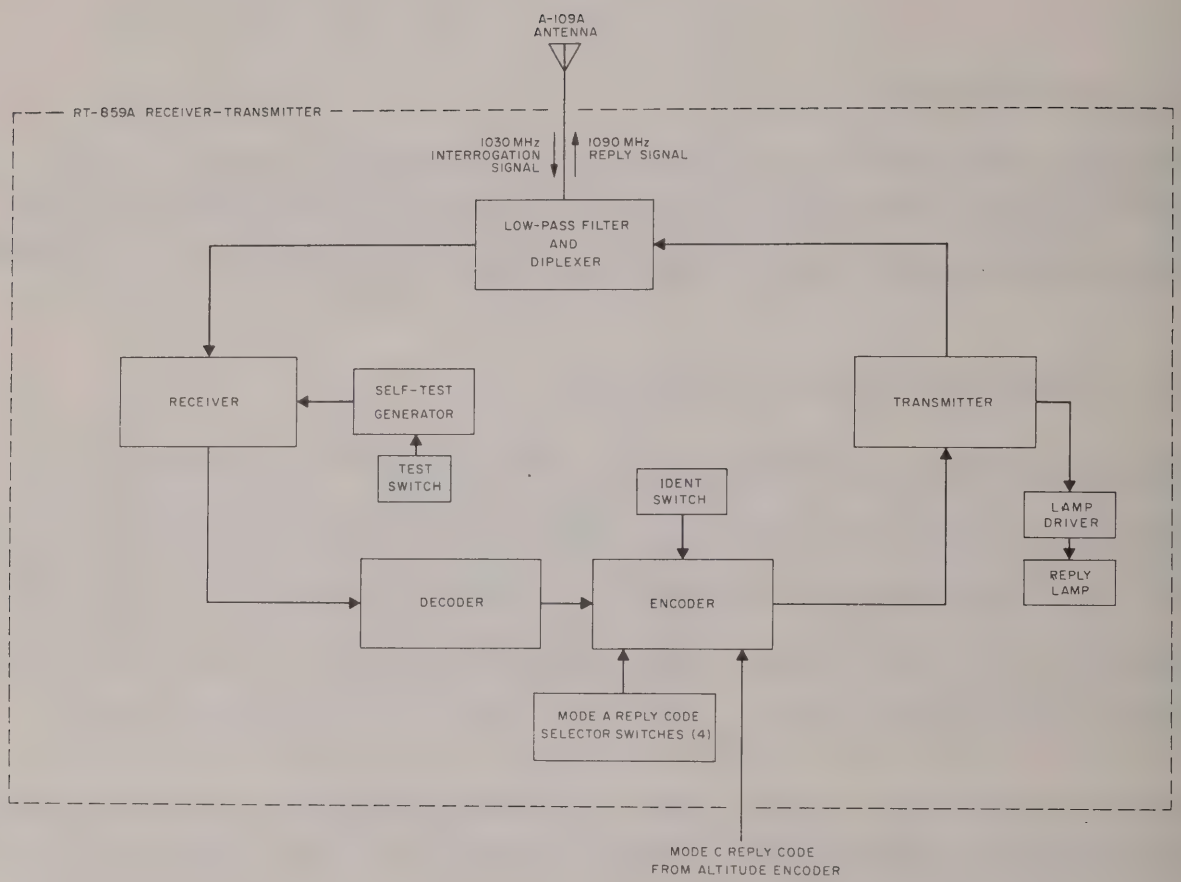


Figure 4-1. RT-859A Transponder Signal Distribution Block Diagram

In the decoder, the video signal from the gate is applied simultaneously to three of five multivibrator circuits (Mode A or alternate Mode A, Mode C or alternate Mode C, and sidelobe suppression) where the video signal is examined for the time space between the interrogation pulses to determine if the interrogation is a valid mainlobe signal (pulse P2 is 9 dB below P1) and to determine the mode of interrogation. When a valid Mode A or Mode C interrogation is recognized, the discrete multivibrator supplies a trigger gate to start the strobe multivibrator. A mode latch signal is also applied to the encoding circuit to enable the encoder to generate the selected reply code for the interrogation mode.

When the encoder is triggered, it generates a trigger pulse to block the decoder for the duration of the transponder reply. The signal from the decoder strobe multivibrator starts the encoder clock circuit, the clock generates a sine wave which is converted into timing pulses for positioning the selected reply pulses.

The Mode A reply code is selected by the combined position of the four code selector switches on the front panel of the receiver-transmitter. These switches control information gates in the encoder which determine the presence or absence of the twelve information pulses in the reply pulse train. An altitude encoder (when included in the installation) determines the information pulses used in the reply to a Mode C interrogation. The IDENT pulse is selected by a pushbutton switch on the front panel. When depressed, the switch activates a timing circuit in the encoder which holds the IDENT gate open for a fixed time period so that the IDENT pulse is included in the transponder reply for one sweep of the radar antenna.

The selected reply pulses from the encoder are applied to the transmitter as trigger pulses. These triggers are converted into essentially rectangular pulses which are used to pulse-modulate the transmitter power oscillator. Output pulses are coupled through the diplexer and lowpass filter circuits, where harmonics of the transmitter output frequency are suppressed. The 1090-MHz reply signal is applied to the antenna for transmission. A sample of the modulator output is amplified and applied to a lamp driver circuit to light the REPLY lamp on the front panel of the receiver-transmitter to provide an indication of transponder reply.

A self-test generator, selected by the TEST switch on the front panel, provides a modulated RF signal to check the operation of the receiver, Mode A decoder, encoder, and transmitter. Indication of proper operation is displayed by the REPLY lamp on the front panel.

4-3. LOWPASS FILTER - DIPLEXER.

(Refer to Figure 6-1). The lowpass filter-diplexer circuit provides both the input and output circuits for the transponder. The A-109A antenna, connected through the antenna cable to the lowpass filter, is used for both reception of the 1030-MHz interrogation signal and the transmission of the 1090-MHz reply signal. Lowpass filter

A1 provides only about 0.2 dB attenuation at transponder frequencies. It has a cutoff frequency of 1200 MHz; above 1200 MHz, the filter provides increasing attenuation to any harmonics in the transmitter output signal.

The diplexer prevents the transmitter from loading the incoming 1030-MHz signal and isolates the 1090-MHz transmitter output signal from the receiver preselector. The diplexer consists of cables A2A1W1 and A3W1, which connect the lowpass filter to receiver preselector A2A1 and to transmitter oscillator A3. These cables are cut to critical lengths to pass the appropriate frequency and to reject all other frequencies.

4-4. RECEIVER.

General. As shown in Figure 4-2, the receiver consists of preselector A2A1 and IF assembly A2A2. It uses a superheterodyne circuit to convert the 1030-MHz interrogation signal into video pulses for use in the decoder. IF assembly A2A2 includes a crystal-controlled local oscillator, a "hot-carrier" diode mixer, a logarithmic IF amplifier, video detector, video amplifier, narrow pulse discriminator, and sidelobe suppression circuits.

Preselector. Preselector A2A1 is a bandpass RF filter tuned to pass the 1030-MHz transponder interrogation signal. It presents at least 60 dB attenuation for all signals outside the 1030-MHz frequency band. The assembly consists of four resonant stubs enclosed in a shield. Input connections are made through a specially fabricated coaxial lead (A2A1W1) connected between lowpass filter A1 and the 50-ohm point of the input stub. Output to the receiver mixer circuit is made through a short lead connected between the 50-ohm point of the output stub through the shield to A2A2.

Local Oscillator. The receiver uses a crystal oscillator and multiplier circuit to produce the local oscillator signal of 485.00 MHz. The circuit for oscillator A2A2Q6 is controlled by crystal A2A2Y1 (161.667 MHz), which is operated in the seventh overtone, series-resonance mode. A tank circuit (A2A2T1 and A2A2C17-C19) tuned to 161.667 MHz supplies oscillator feedback. The oscillator output is coupled through harmonic-tripler diode A2A2CR1 to a tank circuit formed by A2A2L5 and A2A2C16, which is tuned to the third harmonic of the oscillator signal. The 485-MHz local oscillator signal is applied to the mixer circuit.

Mixer. Mixer diode A2A2CR2 is a "hot-carrier" diode selected for high efficiency. The 1030-MHz RF signal from the preselector is coupled through A2A2C1 and a short length of resonant line to the mixer. A2A2CR2 is operated in the harmonic mode so that the second harmonic of the local oscillator signal (970 MHz) is mixed with the 1030-MHz interrogation signal to produce the 60-MHz IF frequency. A 60-MHz tank circuit in the mixer output couples the 60-MHz signal to the IF amplifiers.

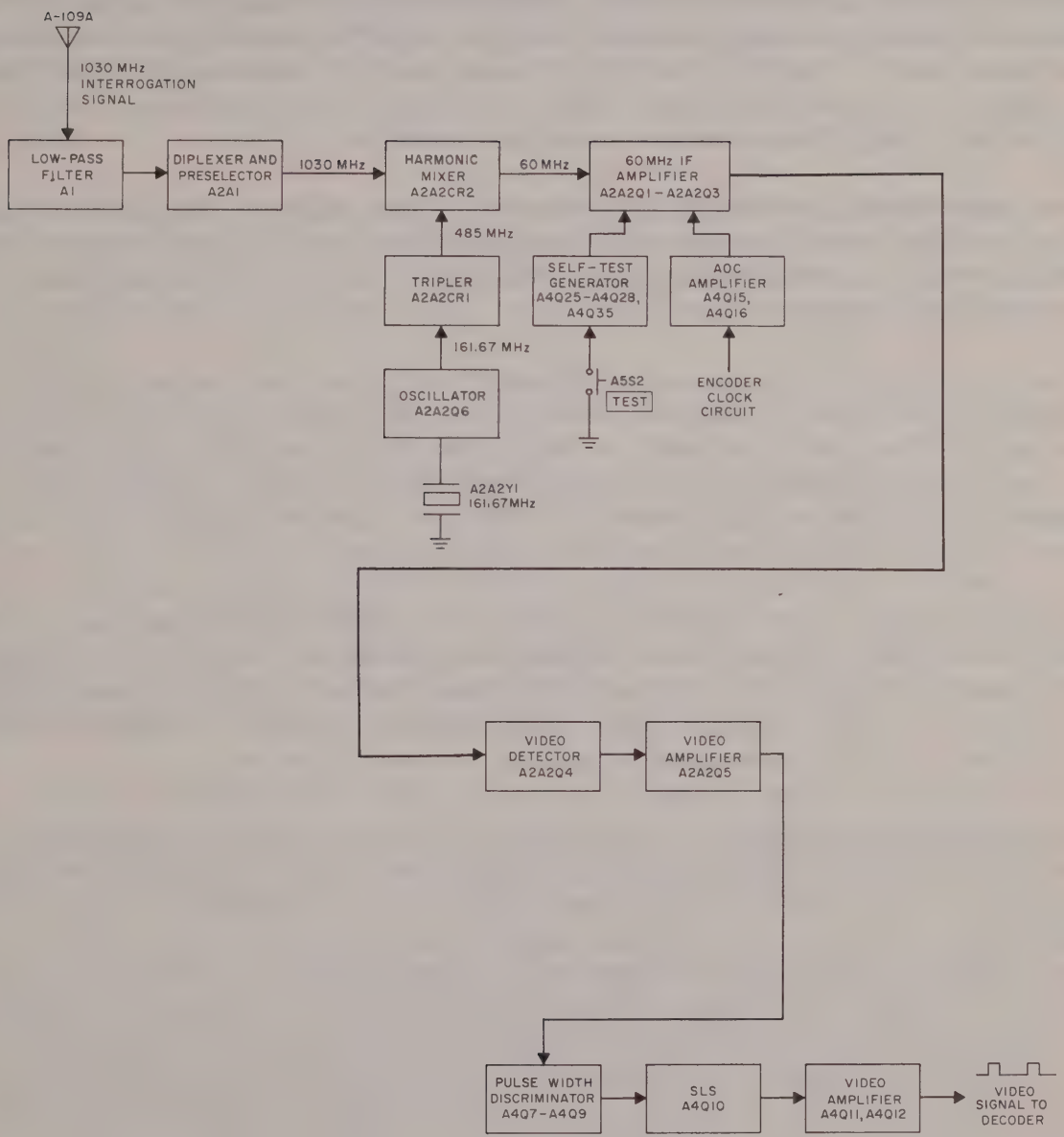


Figure 4-2. RT-859A Receiver-Transmitter, Receiver Circuit Block Diagram

IF Amplifier - Video Detector. An IF amplifier circuit with a logarithmic response is used to amplify the 60-MHz IF signal and to detect it for the video component. DC base current is supplied to A2A2Q1, A2A2Q2, A2A2Q3, and A2A2Q4 through A2A2R1, A2A2R6, A2A2R11, and A2A2R16, respectively. Since the collector voltages are fixed at about +9 volts, the base-emitter voltages are equal when no signal is present. When a 60-MHz signal is present, the base-emitter voltages are varied by the detector action on the base-emitter junction. A2A2Q4 detects weak video signals which are amplified in the first three stages. A2A2R5, R8, R10, and R13 provide video coupling between stages. As the signal voltage is reduced, the resistor coupling reduces the voltage on the preceding stages, thus reducing the current and gain of the stage and providing a logarithmic response to signal variation.

Bandpass filtering and interstage coupling are accomplished by the tuned circuits and small coupling capacitors in the output of the three amplifier stages. The video signal from the detector is coupled to video amplifier A2A2Q5 through lowpass filter A2A2R15 and A2A2C23.

During periods of high interrogation rates, when the transponder is receiving interrogations from several stations or from noise, the receiver gain is automatically reduced to limit the reply rate. DC base current to A2A2Q1 through A2A2R1 and R2 is reduced by an automatic overload control circuit in the transponder. Since the gain of the amplifier is a function of the dc base current, the gain of the circuit is reduced for as long as the overload condition persists.

Video Amplifier. Video amplifier A2A2Q5 is a variable gain, feedback-controlled amplifier directly coupled to the output of the video detector. The peak output signal from the amplifier is +2.5 volts at 50 dB above minimum triggering level (MTL). Gain of the amplifier can be adjusted by video gain control A2A2R23. Output from the amplifier is applied to the pulse width discriminator circuit.

Pulse Width Discriminator. The pulse width discriminator circuit examines the width of the interrogation pulses and reduces the receiver sensitivity to signals with pulses narrower than the normal interrogation pulses. A2A2Q7 is a phase-splitting amplifier which drives an all-pass delay network composed of A2A2C24, A2A2L7, A2A2C25, A2A2R28, and A2A2R39. It provides a time-delayed version of the video signal to the base of A2A2Q8 and an undelayed version to the base of A2A2Q9. Since the signal is inverted as it passes through the delay network, it appears on the base of A2A2Q8 as a positive pulse delayed by 0.3 USEC. Normally, both A2A2Q8 and A2A2Q9 are biased on and their emitters are low, holding A2A2Q10 turned off. If a video pulse wider than the circuit delay time is applied to the pulse width discriminator, both A2A2Q8 and A2A2Q9 are turned off and A2A2Q10 is turned on, and an output signal is applied to the sidelobe suppression circuit.

Sidelobe Suppression. The sidelobe suppression circuit enables the receiver to distinguish between mainlobe interrogation signals where P2 is at least 9 dB below P1, and sidelobe signals where P2 is less than 9 dB below P1. An effective reduction

of receiver sensitivity for a short time after a signal appears is accomplished by the non-linear action of ramp generator A2A2Q10. Any positive signal appearing on the base of the transistor causes A2A2C28 to charge to the peak of the signal, after which it decays back to its original level. As long as the charge remains on A2A2C28, A2A2Q10 is less sensitive to incoming signals. Ramp decay rate is adjusted by A2A2R33, and is usually set for 8 USEC for a signal 28 dB above MTL. This allows the receiver to regain full sensitivity 8 USEC after P1 is applied to the circuit. The video signal from A2A2Q10 is amplified in A2A2Q11 and coupled through emitter-follower A2A2Q12 to the decoder gate circuits.

4-5. DECODER.

As shown in Figures 4-3 and 6-1, the decoder consists of one-shot multivibrators and gating circuits which examine the video output signal from the receiver to determine if it is a valid (main beam) interrogation and to determine the interrogation mode. If the signal is a valid interrogation, the decoder supplies a gating signal to start the encoder.

A positive pulse in the video signal from the receiver is applied simultaneously to an input of buffer gates A4U2A, A4U2B, and A4U2C. The other input to A4U2A is connected to the output of the strobe multivibrator in the decoder and is normally high, while the other inputs to A4U2B and A4U2C are connected respectively to the outputs of the Mode A and Mode C multivibrators and are normally low. The two positive pulses through A4U2A produce a negative pulse at the output of the gate. This negative pulse is differentiated by A4C4, A4C7, and A4C10 to produce negative spikes to trigger the Mode A, the Mode C, and the SLS multivibrators. The pulse is also differentiated by A4C1 and applied as a short negative spike to the common inputs of decoding gates of A4U3A, A4U3B, A4U3C, A4U3D, and A4U4D.

Except for the time constant of the output pulses, operation of the five decoding multivibrators is the same. The time constant for each is established by an external resistor and capacitor circuit selected for the discrete multivibrator function. Operation of the Mode A multivibrator is described in the following paragraphs.

Normally, A4Q1 of the Mode A multivibrator is biased off, while A4Q2 is biased on. When a negative trigger pulse through A4C4 and A4CR1 is applied to the base of A4Q2, A4Q2 is turned off, allowing the collector voltage to rise. This voltage, applied to the base of A4Q1, turns A4Q1 on, and the collector voltage of A4Q1 drops, pulling the base of A4Q2 low through A4C2.

A4C2 begins to charge through A4R2 towards +8.2 volts. When the base-emitter voltage of A4Q2 reaches the proper operating value, A4Q2 is turned on, turning A4Q1 off, and the multivibrator is returned to its steady state. The operating time of the circuit can be varied by the adjustment of A4R4.

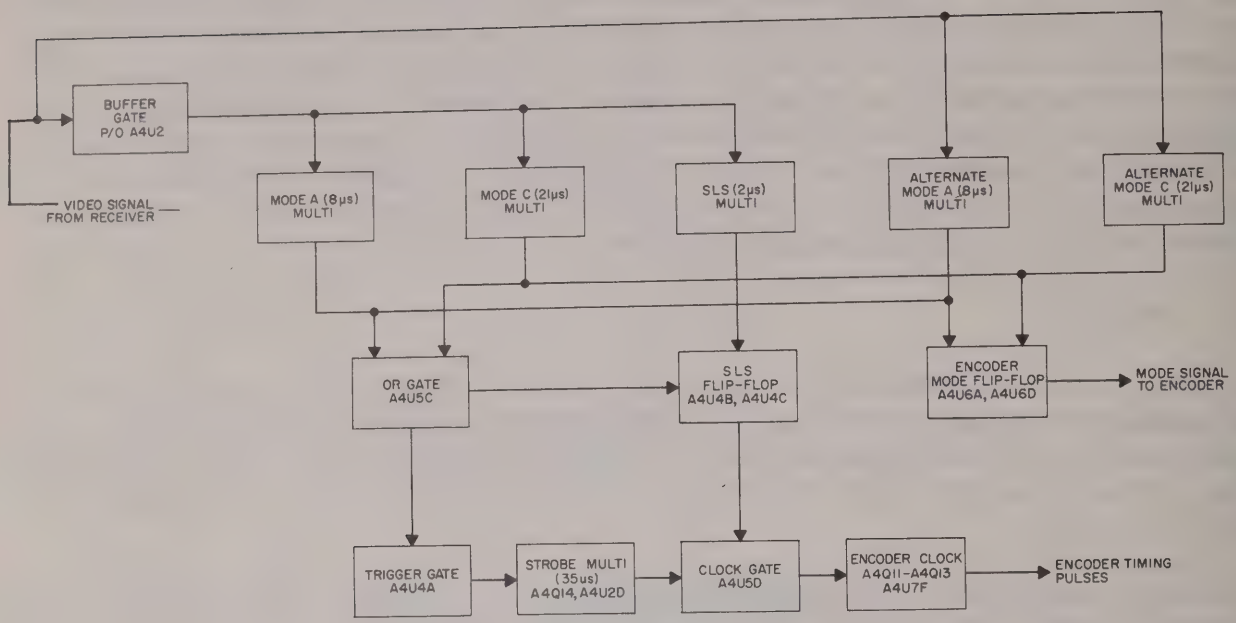


Figure 4-3. RT-859A Receiver-Transmitter, Decoder Circuits Block Diagram

Operating time for the Mode A multivibrator is approximately 7.5 USEC. At the end of this time, the output returns to zero, and the negative-going trailing edge of the output pulse is differentiated by A4C3. A low input trigger is applied to A4U3C, opening the Mode A decoding gate. The time constant established by A4C3 and A4R41 sets the decoding gate width at about 1 USEC, so that the Mode A decoding gate is open from 7.5 USEC to 8.5 USEC after the Mode A multivibrator is triggered. If, during this time, a second pulse from the receiver is passed through A4U2A and A4C1 and appears at the common gating input for A4U3C as a negative-going spike, both inputs of A4U3C are low at the same time, and a Mode A trigger pulse is produced.

Mode C and SLS interrogations are decoded in a similar manner.

The alternate Mode A and Mode C multivibrators assure transponder decoding capability in areas of high electrical noise. If a valid interrogation signal is preceded through the receiver by a noise pulse, the alternate multivibrator will decode the signal while the primary multivibrator is tied up by the noise pulse.

During the time that the Mode A multivibrator is operating, a positive signal from the collector of A4Q2 through A4R15 applies a high input to gate A4U2B. A second positive pulse coming from the receiver during this time enables A4U2B, and the negative

pulse output from A4U2B is differentiated by A4C15 to trigger the alternate Mode A multivibrator. The alternate Mode C multivibrator is activated in a similar manner.

The output from either of the Mode A decoding gates (A4U3C or A4U3B) is connected to OR gate A4U6A of the mode flip-flop multivibrator in the encoder, and to one input of OR gate A4U5C. The output of either of the Mode C decoding gates (A4U3D or A4U3A) is connected to OR gate A4U6D of the mode flip-flop multivibrator, and to the other input of OR gate A4U5C. A signal from any of the mode decoding gates through A4U5C is applied to OR gate A4U4B in the SLS flip-flop, and to OR gate A4U4A to trigger the strobe multivibrator. The output of the SLS decoding gate is connected to SLS flip-flop A4U4C, and also directly to OR gate A4U4A to trigger the strobe multivibrator.

When a Mode A or a Mode C interrogation pulse pair is decoded, the positive pulse from OR gate A4U5C applied to the input of AND gate A4U4B of the SLS flip-flop retains the flip-flop in its steady state. The strobe output pulse of the strobe multivibrator from AND gate A4U2D is coupled through inverter gate A4U7E and OR gate A4U5D to activate the encoder. It is also returned to input gate A4U2A to turn off the decoder for approximately 35 USEC.

If an SLS interrogation is decoded, the pulse from A4U4D applied to A4U4C in the SLS flip-flop switches the circuit. A low pulse at the output of A4U4C is applied to the input of AND gate A4U5D at the same time the strobe pulse through A4U7E (a high pulse) is applied to the input of A4U5D AND gate A4U5D is blocked, and no strobe pulse is applied to the encoder.

4-6. ENCODER.

As shown in Figure 4-4, the encoder uses a ring counter composed of nine J-K flip-flop circuits to control information gates to generate a series of precisely spaced pulses in reply to an interrogation signal. The pulses for a Mode A reply are selected by the four code selector switches on the front panel. The pulses for a Mode C reply are selected by an external altitude encoder. (Refer to Figure 6-1). One-half of A4U10, and both circuits of A4U11, A4U12, A4U13, and A4U14 comprise the encoder counter circuit. Of these, Pins 3 and 11 are connected as J inputs, and Pins 2 and 12 are connected as K inputs. The nine J-K flip-flops comprise a switch-tail ring counter which generates the 18 discrete states necessary for encoding. Each particular state of the counter is selected by a single two-input gate.

The strobe pulse from the decoder is applied to inverter gates A4U7A and A4U7D in the encoder. A4U7A operates the clock circuit, and A4U7D provides a turn-on pulse through AND gate A4U9A for the ring counter.

A4U9A controls the reset line of the counter and gates the counter on and off. When the output of A4U9A is low, the counter is reset to its zero state and Pins 6 and 8 of

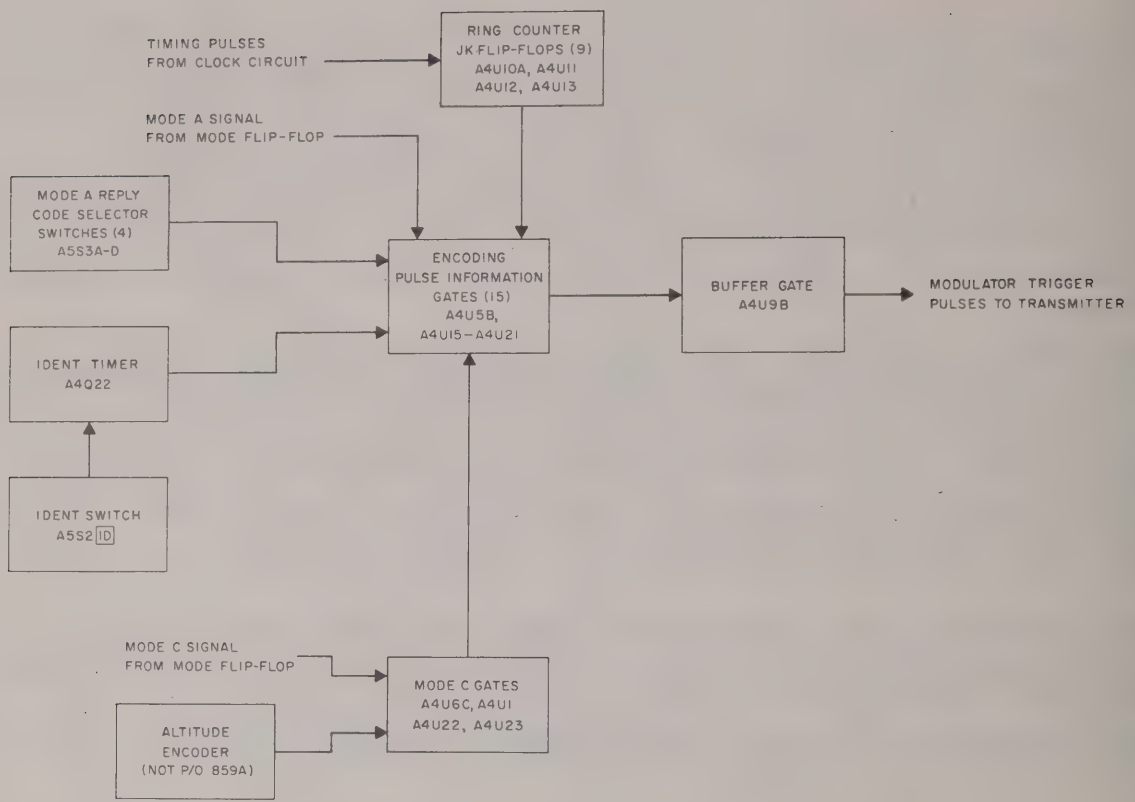


Figure 4-4. RT-859A Receiver-Transmitter, Encoder Circuits Block Diagram

the J-K flip-flop are high. While the reset line is low, the counter will not clock into the next state. Inputs 10 and 12 of A4U9A are connected to outputs A and J of the counter, which are high during the counter zero state. Inputs 9 and 13 of A4U9A are normally held high by the output of A4U7B. When a strobe pulse arrives from the decoder, the output of A4U7D is differentiated by A4C25 and A4R53, and inputs 9 and 13 of A4U9A are momentarily driven low. The resulting high output from A4U9A enables the counter.

In the clock circuit, A4Q11 and A4Q13 are normally on, and A4Q12 is normally off. When A4Q13 is turned off by the strobe pulse from A4U7A, the inductive-capacitive circuit composed of A4L2 and A4C21, C22, and C23 is shocked into oscillation by the change in collector current. The positive voltage excursion through this circuit turns A4Q11 off; with A4Q11 turned off, A4Q12 is turned on, and a series of pulses appear at the collector of A4Q12. These pulses are inverted and squared in A4U7F. J-K flip-flop A4U10B changes state with each pulse from A4U7F, and the output at Pins 8 and 9 of A4U10B is one-half the clock frequency.

At rest, each of the J-K flip-flops except A4U11A has a high J input and a low K input, so that the Q output will not go low when the circuit is clocked by the pulse through A4U7C. When the first clock pulse is applied to the counter, only A4U11A changes state; Pin 6 of A4U11A goes low and remains low. After the first clock pulse, A4U11B is enabled by A4U11A, and the second clock pulse causes Pin 8 of A4U11B to go low. In this manner, the transition of each flip-flop enables the one following; the action continues until the pulse from A4U10A returns A4U11A to its original state after the tenth clock pulse. Succeeding clock pulses cause the counter to revert to its original state, one flip-flop at a time. After the eighteenth clock pulse, Pins 10 and 12 of A4U9A are high and Pin 8 is low; the reset line is lowered, and the counter stops.

A series of NAND gates, controlled by one of the four Mode A reply-code selector switches or by the Mode C altitude encoder, is used to select the discrete counter pulses to be used in the transponder reply. The mode flip-flop (A4U6A and A4U6D) determines whether a Mode A or a Mode C reply is selected. For a Mode A reply, a low pulse from decoder gate A4U3B or A4U3C is applied to the input of A4U6A. A high pulse at the output of A4U6A holds the output A4U6D low, which in turn applies a gating signal through the mode selector switches to activate the pulse NAND gates. The high output from A4U6A is also applied through A4U6B, so that a low pulse from A4U6B is applied to one input of each of the Mode C OR gates (A4U6C, A4U22, and A4U23), and the Mode C gates are not activated.

Since the common line for the Mode A switches receives a low pulse from the output of A4U6D, the discrete pulse NAND gate is closed as long as the selector switch is closed. When the switch is open, the pulse NAND gate is also open, and a pulse appears at the NAND gate output every time the counter is cycled. The encoded pulses are gated through A4U5A and A4U9B and applied to the modulator circuit.

Adjacent pulses applied to Pin 2 of A4U9B appear as one long pulse. To separate the information present in these pulses, the output at Pin 9 of J-K flip-flop A4U10B is connected to A4U9B input Pin 4. The waveform at this point is high only during the last half of each pulse appearing in the output of A4U5A, so that only the last half of the input pulse at Pin 2 of A4U9B appears in the output as a modulator trigger.

When the IDENT pulse is selected by pushing in the ID button on the front panel, the IDENT timer circuit is activated. A 4C36 is discharged through A4R86 and A5S2 and pulls the base voltage of A4Q27 toward -8.2 volts. A4C36 then begins charging towards +5 volts through A4R84. The base voltage for A4Q22 rises and A4Q22 is turned on. The collector output of A4Q22 is applied to IDENT NAND gate A4U15A in the encoder. If A4U15A also receives a Mode A gating pulse from A4U6A in the encoder flip-flop, the NAND gate is turned on for the duration of the IDENT timer cycle, and the output of A4Q22 is also applied through gates A4U8B and A4U8C and lamp driver A4Q24 to light the reply lamp.

For a Mode C reply, a low pulse from decoder gate A4U3A or A4U3D is applied to A4U6D of the mode flip-flop, and the high output of A4U6D holds the output A4U6A low. Since the high pulse from A4U6D is also applied to the common line for the Mode A selector switches, the Mode A encoding gates are blocked, regardless of whether the selector switches are open or closed. The common input for the Mode C OR gates is high because of the high output of A4U6B, and the output of the gates is controlled by the input from the altitude encoder. A logic 0 on any altitude input line will gate the reply pulse for its respective position. When no altitude encoder is used, the lines are pulled high by the internal gate circuitry and the OR gate outputs are low. The encoding NAND gates are closed and only the framing pulses F1 and F2 are applied to the modulator.

The altitude encoder is enabled when the ALT pushbutton of switch assembly A5S2 is pushed in. When the ALT button is in the out position, the Mode C common line to the altitude encoder is interrupted and no altitude information is transmitted; only the framing pulses will be transmitted in reply to a Mode C interrogation.

4-7. TRANSMITTER.

The transponder transmitter consists of a modulator one-shot multivibrator and transistor switch, a power oscillator, and a reply lamp indicator circuit. (See Figures 4-5 and 6-1). In the quiescent condition, A4Q17 of the one-shot multivibrator is normally off and A4Q18 is normally on. A reverse bias through A4R67 and A4R72 is applied to the base of transistor switch A4Q19.

When reply pulse triggers from A4U9B are applied to the modulator multivibrator, the triggers are differentiated by A4C30 and applied to the base of A4Q17. A4Q17 is turned on and the collector voltage rises; the base voltage of A4Q18 rises by the same

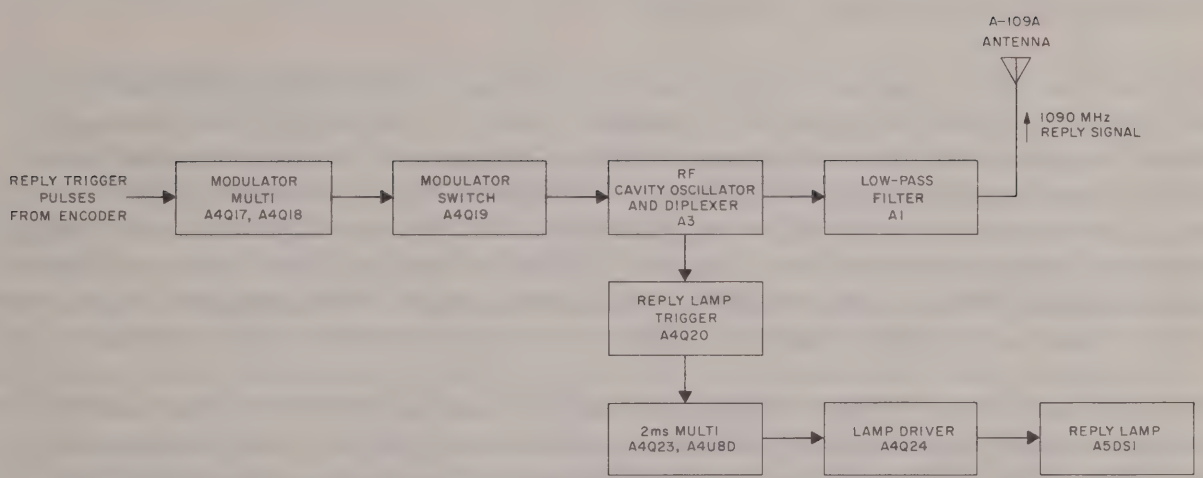


Figure 4-5. RT-859A Receiver-Transmitter, Transmitter Circuit Block Diagram

amount and turns off A4Q18. A4Q19 is turned on and held on by the base current supplied by A4Q17 through A4R75 and A4R72.

The duration of the multivibrator ON time determines the width of the reply pulse. The circuit remains in this quasi-stable state for only a short time; A4C31 begins to charge through A4R65 and A4R66, returning the base voltage for A4Q18 to the steady-state value. A4Q18 is turned on and A4Q17 is turned off until another trigger from the encoder is applied to the circuit. The multivibrator pulse width is adjusted by A4R66.

Normally, transistor switch A4Q19 is biased off, holding the cathode voltage of the power oscillator steady. When a positive pulse from the multivibrator is applied to the base of A4Q19, A4Q19 is turned on for the duration of the pulse and applies a modulating signal to the power oscillator.

The transmitter RF circuit is a triode tube operated as a grounded-grid, cathode-pulsed power oscillator mounted in a resonant cavity. The length of the anode line, which is foreshortened by the tube anode-grid capacity and a small variable capacitor that provides fine tuning adjustment, determines the transmitter output frequency. Feedback is accomplished by a lead attached to the cathode and extending through the tube grid flange into the anode area of the cavity. The cathode circuit is broadbanded. Power output from the oscillator is capacitively coupled to the low-pass filter by a probe connected through the cavity wall and diplexer cable A3W1.

When transistor switch A4Q19 is turned on by the pulse output of the one-shot multivibrator, the cathode voltage of the power oscillator is lowered, and oscillation begins. Bursts of RF energy are generated according to the pulse signal applied to the cathode by transistor switch A4Q19. The pulse-modulated output is coupled through the diplexer and lowpass filter to the antenna.

The reply lamp indicator circuit provides a visual indication of transponder operation. In addition to the panel-mounted indicator lamp, the circuit includes a trigger transistor, a 2 USEC multivibrator, control gates, and a lamp driver transistor. When the modulator circuit is activated by the pulses from the encoder, a positive trigger signal from the emitter circuit of A4Q19 is amplified by A4Q20 and applied to A4Q23 in the 2 USEC multivibrator. A4Q23 is turned off by the trigger signal, activating gate A4U8D. A low pulse at the output of A4U8D drives the output gate A4U8C high to turn on lamp driver A4Q24 for the duration of the multivibrator ON time. The output from A4Q24 energizes reply lamp A5DS1. The brilliance of A5DS1 is controlled automatically by an ambient-light sensing circuit.

4-8. AUTOMATIC OVERLOAD CONTROL (AOC).

The automatic overload control circuit limits the reply rate of the transponder when the rate of interrogation is excessive, or in an area where interrogations from several

ground stations are being received simultaneously. The AOC circuit reduces the gain of the IF amplifier so that the transponder does not reply to the weaker signals.

AOC amplifier A4Q15 provides a constant current source for A2A2R2 in the receiver assembly and for A4C29 and bleeder transistor A4Q16 in the AOC circuit. The average base bias for A4Q16, which is proportional to the transponder reply rate, is zero during periods of no reply. A strobe pulse from the output of A4U7D in the coder circuit momentarily turns on A4Q16, and the voltage on A4C29 drops. Successive strobe pulses from A4U7D produce the same effect, until the rate exceeds a preset number of replies per second. At this point, the voltage on A4C29 drops sharply, varying the current supplied to A2A2R2 and reducing the gain of the IF amplifier. When the interrogation rate drops below the preset limit, full IF gain is restored. The reply limit is determined by the adjustment of A4R57.

4-9. SELF-TEST CIRCUIT.

The self-test oscillator circuit generates a pulse-modulated RF signal for checking the operation of the receiver, Mode A decoder, encoder, and transmitter circuits of the transponder. The signal is injected directly into the first IF stage of receiver assembly A2A2; except for operation of the REPLY lamp circuit, operation of the remaining transponder circuits is the same as for a regular interrogation. (See Figure 6-1). The self-test circuit is energized when the TEST switch of A5S2 is depressed. Oscillator A4Q26 produces a 60-MHz RF carrier, and oscillator A4Q25 produces 1 USEC pulses spaced 8 USEC apart. Unijunction oscillator A4Q27 establishes the 450-Hz interrogation rate. A4Q28 provides overall circuit control; A4Q35 bypasses the automatic dimmer control circuit to allow REPLY lamp A5DS1 to light to full brilliance as an indication of satisfactory self-test operation.

The operating potential for A4Q25 and A4Q26 is established so that conduction occurs in A4Q26 for only 1 USEC during the peak of the 125-kHz sine wave. Since the ground return for A4Q26 is through A4R109 and A4Q28, A4Q26 can conduct only when A4Q28 is turned on through A4Q27. Thus, when the TEST switch is depressed, A4Q27 conducts, A4Q28 is turned on, and the circuit prodcues 60-MHz pulses with 8 USEC spacing. The base circuit time constant for A4Q28 is established so that 3 or 4 60-MHz pulses are produced for each interrogation.

SECTION 5

MAINTENANCE

5-1. INTRODUCTION.

This section contains maintenance information for the RT-859A Receiver-Transmitter. It includes removal and replacement procedures, equipment performance tests, and alignment and adjustment procedures. Reference to the principles of operation described in Section 4 and to the schematic and wiring diagrams in Section 6 will aid in diagnosing and localizing trouble.

Unusual terms used in the procedures in this section are defined as follows:

A. Minimum Triggering Level (MTL). Transponder minimum triggering level is the lowest input signal level to which the transponder will generate 90% replies when interrogated with a standard Mode A or Mode C interrogation.

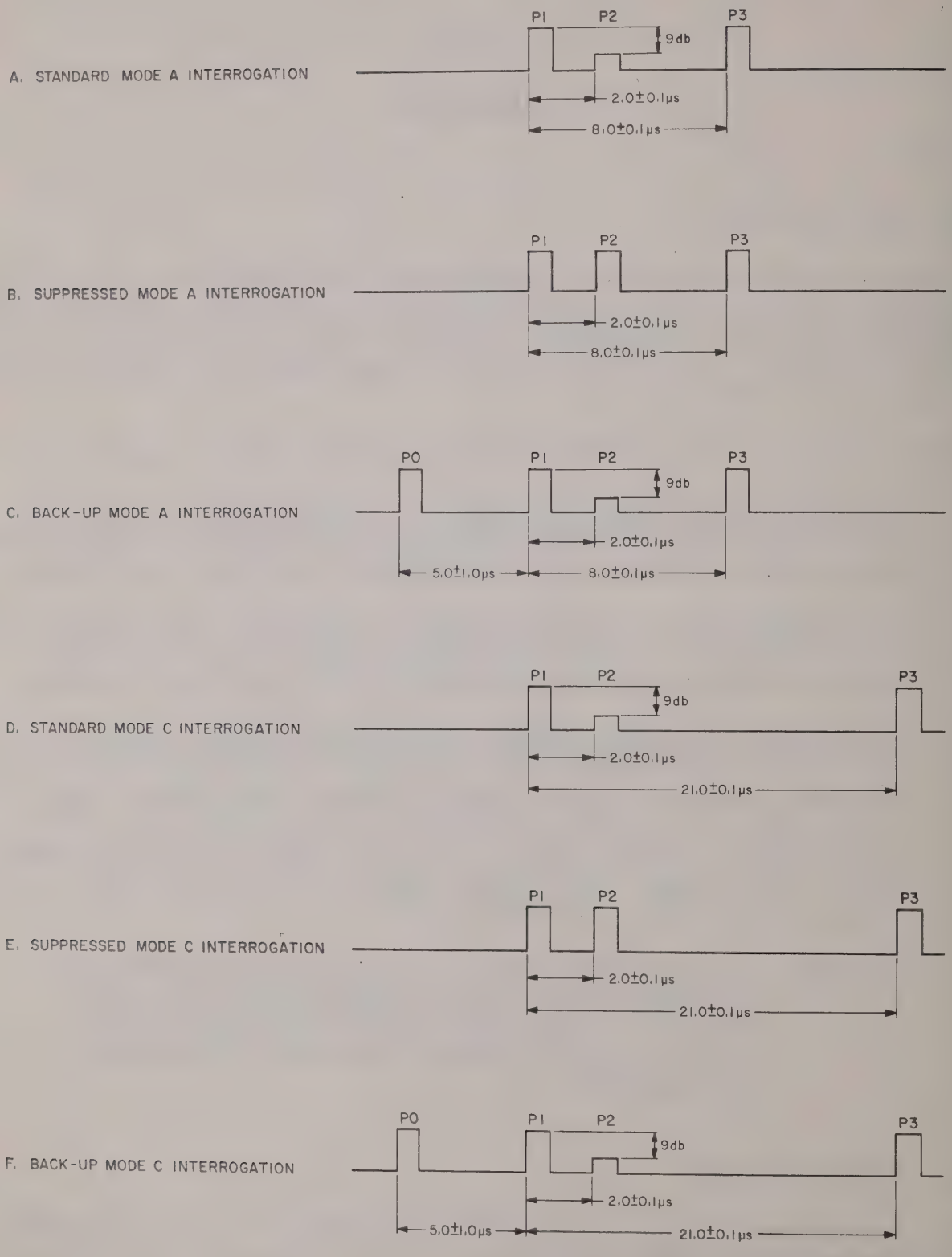
B. Dynamic Range. Transponder dynamic range is the range of signal levels in dB to which the transponder will reply with greater than 90% efficiency when interrogated with a standard Mode A or Mode C interrogation signal.

C. Standard Interrogation Signal. A standard interrogation signal at 1030-MHz consists of three pulses: P1, P2, and P3. Pulses P1 and P3 are of equal amplitude; P2 is 9 dB below P1. Spacing between pulses, leading edge to leading edge, is 2 ±0.1 USEC between P1 and P2, and 8 ±0.1 USEC or 21 ±0.1 USEC between P1 and P3. Pulses P1, P2, and P3 have the following characteristics: rise time, less than 0.1 USEC; decay time, less than 0.2 USEC; pulse width, 0.8 ±0.1 USEC. (See Figure 5-1).

WARNING: +1400 VOLTS IS PRESENT AT ALL TIMES IN THE RECEIVER-TRANSMITTER WHEN THE TRANSPONDER IS ON. OTHER VOLTAGES USED IN THE RECEIVER-TRANSMITTER MAY ALSO BE FATAL IF CONTACTED. OBSERVE ALL SAFETY PRECAUTIONS.

5-2. TEST EQUIPMENT.

Table 5-1 lists the test equipment required for maintenance of the 859A Transponder. If the Hewlett-Packard 8925A DME/ATC Test Set is available, equipment included in the test set need not be duplicated. Equivalent test equipment may be substituted for



TP 5529

Figure 5-1. Bench Test Transponder Interrogation Signals

that listed. Cable assemblies not supplied as part of test equipment are not listed but must be fabricated as required.

TABLE 5-1. TEST EQUIPMENT

QTY.	NAME	TYPE
1	DME/ATC Test Set	Hewlett-Packard HP8925A
1	ATC Pulse Generator	Tel-Instrument Type T-14A
1	Attenuator, 30 dB	Empire Devices Model AT-50
1	Attenuator, 10 dB	Empire Devices Model AT-57
1	Directional Coupler	Hewlett-Packard Model 776D
1	Electronic Counter, with plug-in unit	Hewlett-Packard Model 5245L/5254C
1	Frequency Meter	Hewlett-Packard Model 536A
1	Oscilloscope, with four trace plug-in unit	Tektronix Model 545B/Model M
1	Peak Power Calibrator	Hewlett-Packard Model 8900B
1	Signal Generator	Hewlett-Packard Model 612A
1	Sweep Frequency Generator	Wavetek Model 1005
1	Voltmeter	Hewlett-Packard Model 412A

5-3. REMOVAL AND REPLACEMENT.

General. The receiver-transmitter may be serviced in the field; however, replacement parts must be identical to the original parts to ensure optimum performance (refer to the parts lists in Section 7). Procedures for disassembly of the receiver-transmitter are obvious upon inspection of the unit. To locate and identify the assemblies and the component parts, refer to the wiring and part location diagrams in Figures 6-2, 6-3, and 604.

A3, Cavity Oscillator. Either of two types of cavity oscillators may be installed in the receiver-transmitter. Replacement cavities are supplied in kit form, since the mounting arrangement and diplexer cable A3W1 for each type are different. Wiring information for both cavities is shown on Figure 6-2. When a replacement cavity kit is not the same as the original part, diplexer cable A3W1 must be replaced with the cable supplied with the replacement kit. See Figure 6-2 and unsolder A3W1 at the connection to lowpass filter A1. Solder replacement cable to A1 as shown in wiring detail.

A2, Receiver Assembly. Both subassemblies A2A1 and A2A2 are enclosed with shield covers. Preselector assembly A2A1 is not repairable; diplexer cable A2A1W1 is part of preselector assembly and must be replaced with A2A1. IF assembly A2A2 may be adjusted or repaired as required. Remove the shield cover from A2A2 to gain access to the components mounted on the printed circuit board.

5-4. BENCH TEST INTERCONNECTIONS.

Interconnection of Transponder. A bench test cable assembly (not supplied) must be fabricated to connect the transponder set for bench testing. Refer to the interconnection diagram in Figure 2-5 and prepare the interconnecting wiring as shown. If an altitude encoder is not included in the bench test setup, single-pole, single-throw toggle switches may be connected between the Mode C pulse selector leads and ground to select the pulses for checking the Mode C gating circuits.

Interconnection of Transponder and Test Equipment. Interconnecting cables between the transponder and test equipment (when not supplied as test equipment accessories) are fabricated as required from RG-58/U coaxial cable and suitable connectors. When Hewlett-Packard DME/ATC Test Set 8925A is used for testing the transponder, refer to the test set instruction manual for interconnection and calibration information. When the 8925A is not available, equivalent test equipment may be substituted. Figure 5-2 illustrates a suggested bench test interconnection for general transponder measurements when the 8925A is not used.

CAUTION: TO PREVENT DAMAGE TO THE TRANSMITTER OSCILLATOR TUBE, A 50-OHM LOAD WITH A LOW VSWR (NOT GREATER THAN 1.5:1) MUST BE CONNECTED TO ANTENNA CONNECTOR A1J1 OF THE RECEIVER-TRANSMITTER WHENEVER THE TRANSMITTER IS TRIGGERED.

Test Points. All adjustment and test points referred to in this section are located in the receiver-transmitter. All terminal and test point designations for coder assembly A4 are stamped on the printed circuit board (see Figure 6-4); those for receiver assembly A2 are not stamped on the unit but are located on Figure 6-3.

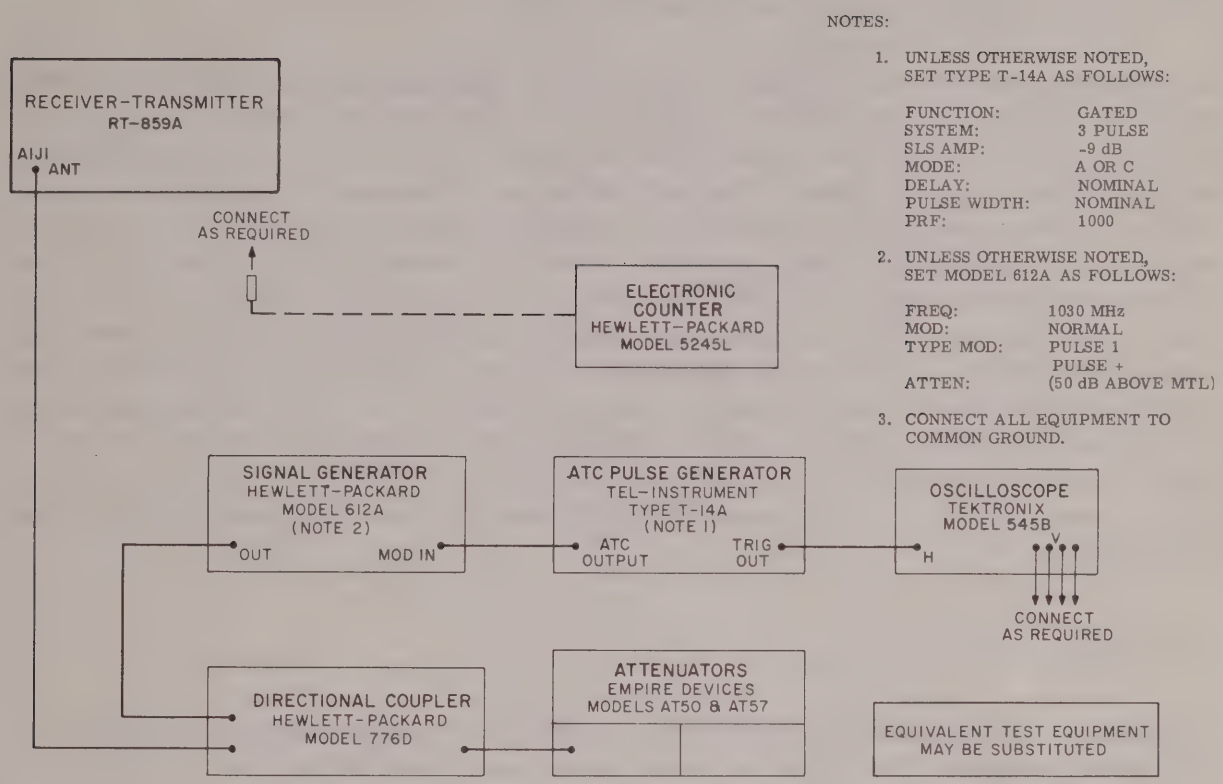


Figure 5-2. Bench Test Interconnect Diagram for General Transponder Measurements TP 5475-1

5-5. PRELIMINARY CHECK AND ADJUSTMENT.

Before the transponder is checked or any other adjustments are made, the output of the voltage regulator circuit should be checked and dc voltage control A4R92 adjusted, as follows:

Step 1. Apply 13.75 ±0.1 Vdc between terminals 22 and 2 of A4J1.

Step 2. Set function switch A5S1 to SBY.

Step 3. Connect Hewlett-Packard Model 412A Voltmeter between terminal A4-4 and ground.

Step 4. Adjust A4R92 as required for an indication of 9.2 ±0.1 Vdc on 412A. Check that input current is less than 1 ampere.

5-6. PERFORMANCE CHECK WITH WAVEFORMS.

The transponder set can be checked for proper operation using the typical waveforms shown in Figure 5-6 for reference. Figure 5-6 also includes a table defining the points of measurement, the oscilloscope settings, the type of interrogation signals, and the selected reply codes. The waveforms are arranged in a numerical order corresponding to signal progression through the transponder. Each waveform presupposes previous satisfactory results. When the waveforms are measured in the order given and a comparable waveform is not obtained, the source of trouble is localized to the circuit being measured. Refer to the logic symbols and truth tables shown on Figure 5-4 and on the schematic diagram, Figure 6-1, for checking the individual integrated circuits, and to the principles of operation in Section 4 for aid in troubleshooting the circuit. Test and adjustment procedures for the receiver, coder, and transmitter are detailed in paragraphs 5-7 through 5-10. For all waveform measurements, the transponder and the test equipment are connected as described in paragraph 5-4.

5-7. RECEIVER ALIGNMENT.

The transponder receiver assembly should require realignment only if the local oscillator transistor (A2A2Q6) or one of the IF amplifier transistors (A2A2Q1 - Q3) has been replaced. To align the receiver, proceed as follows:

Step 1. Interconnect the transponder and test equipment as shown in Figure 5-3, and turn on equipment.

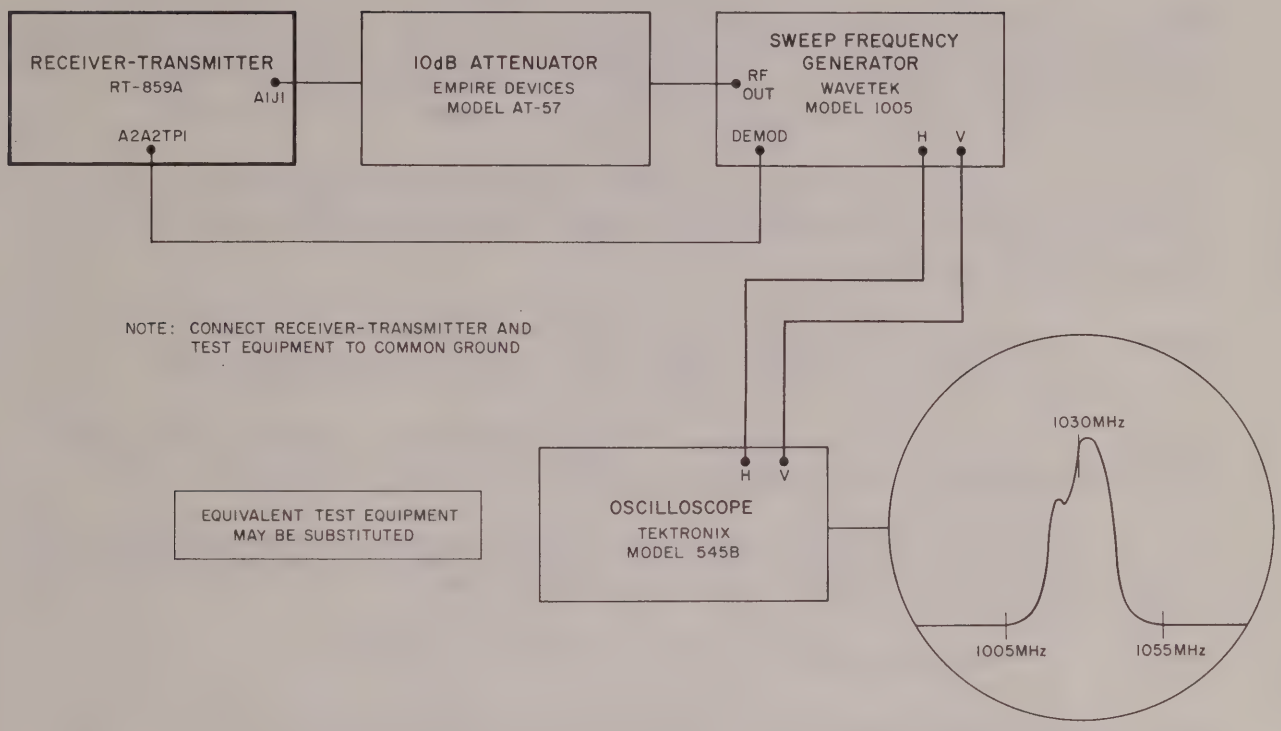
Step 2. Check that A2A2R20 is set to mid-range.

Step 3. Connect Hewlett-Packard Model 412A Voltmeter to emitter of A2A2Q6, and adjust A2A2T1 for maximum dc voltage indication on 412A.

Step 4. Set Wavetek Model 1005 Sweep Frequency Generator as follows: Attenuator, 0 dB; sweep width, full scale display; markers, 1005, 1030, and 1055 MHz; sweep time, 0.1 - 0.01; frequency, 1030 MHz.

Step 5. Deform coils A2A2L2, A2A2L3, and A2A2L4 as required to obtain waveshape on oscilloscope similar to that shown in the detail on Figure 5-3.

Step 6. Reduce input signal as required, and repeat Step 5 until maximum amplitude at the 1030 marker is obtained.



TP 5537-1

Figure 5-3. Bench Test Interconnect Diagram for Receiver Alignment

5-8. TRANSPONDER MINIMUM TRIGGERING LEVEL (MTL) MEASUREMENT AND VIDEO ADJUSTMENT.

To measure the transponder MTL and adjust the receiver video output, proceed as follows:

Step 1. Interconnect transponder and test equipment as described in paragraph 5-4.

Step 2. Connect Hewlett-Packard Model 5245L Counter and vertical input probe of Tektronix Model 545B Oscilloscope in parallel to A4TP9. Turn on all equipment.

Step 3. Set pulse generator for output of 1000 pulses per second, and apply a standard Mode A interrogation signal to transponder.

Step 4. Vary attenuator of signal generator until 1000 pps are generated at A4TP9 (100 percent triggering).

Step 5. Reduce setting of signal generator attenuator until minimum input signal at which transponder replies to 90 percent of interrogations is determined (5245L indicates 900 pps). When Hewlett-Packard Model 776D Directional Coupler is used, attenuator setting should be between -52 and -60 dBm.

Step 6. To determine MTL, add 20 dB to attenuator setting observed in Step 5 to compensate for attenuation of 776D; transponder MTL should be between -72 and -80 dBm.

NOTE: If directional coupler other than the 776D is used, determine attenuation of coupler used to compute the transponder MTL.

Step 7. Vary attenuator setting above and below MTL. Observe that reply lamp on transponder panel lights above MTL, but does not light below MTL.

Step 8. Apply a standard Mode C interrogation to transponder and check that Mode C MTL is within ±1 dB of that observed in Step 5.

Step 9. Connect vertical input probe of 545B to A2A2TP1.

Step 10. Set signal generator attenuator to level 28 dB greater than that observed in Step 5, and apply a standard Mode A interrogation to transponder.

Step 11. Check amplitude of P1 (waveform 1, Figure 5-6); adjust A2A2R23 as necessary for P1 amplitude of 1.1 volts.

Step 12. Connect vertical probe of 545B to emitter of A2A2Q10.

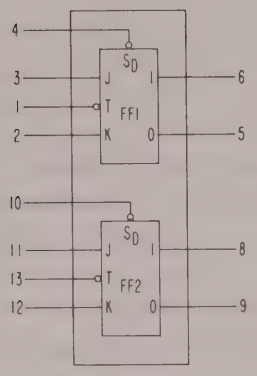
Step 13. Check that the slope of the ramp from P1 intersects the leading edge of the ramp of P3 at the base line (waveform 2, Figure 5-6). If not, adjust A2A2R33 as required to obtain proper waveform.

Step 14. Connect vertical probe of 545B to terminal A2A2-4 and slowly increase input signal to maximum. Check that only pulses P1 and P3 are present in video signal (waveform 3, Figure 5-6).

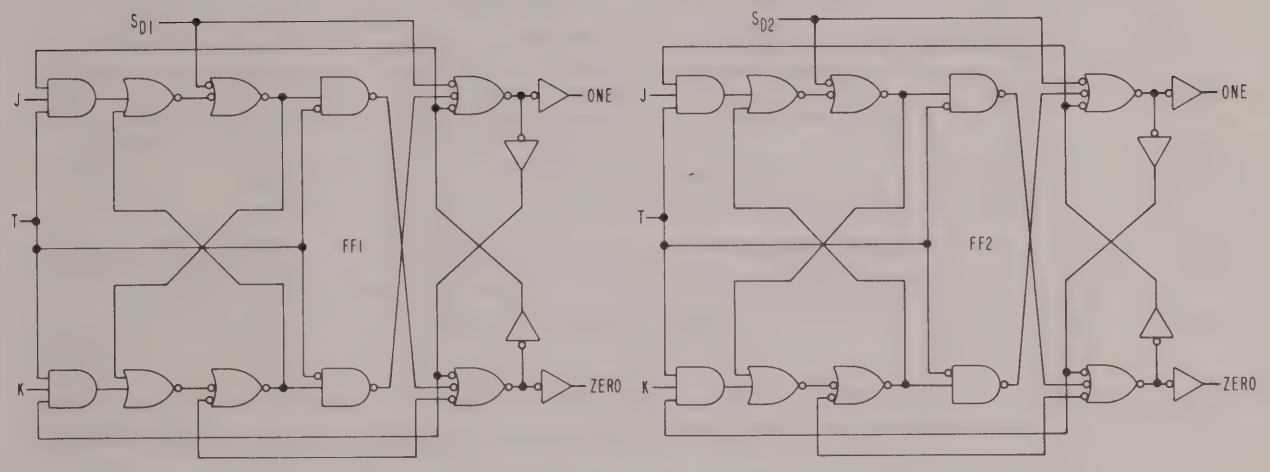
Step 15. Apply a suppressed Mode A interrogation signal to transponder, and again increase input signal to maximum. Check that P2 is present in video signal throughout the range.

5-9. CODER CHECKS AND ADJUSTMENTS.

Before the coder circuits are checked and adjusted, the video output should be checked and the transponder MTL established (paragraph 5-8). Then interconnect the trans-



DUAL J-K FLIP-FLOP
(A4U10-A4U14)



FUNCTIONAL LOGIC DIAGRAM

TRUTH TABLE

BEFORE CLOCK				AFTER CLOCK OUTPUTS	
OUTPUTS		INPUTS			
ONE	ZERO	J	K	ONE	ZERO
L	H	L*	X	L	H
L	H	H*	X	H	L
H	L	X	L*	H	L
H	L	X	H*	L	H

H = STEADY STATE HIGH
L = STEADY STATE LOW
H* = HIGH AT SOME TIME WHILE CLOCK IS HIGH
L* = NOT HIGH AT ANY TIME WHILE CLOCK IS HIGH
X = HAS NO EFFECT ON NEXT STATE

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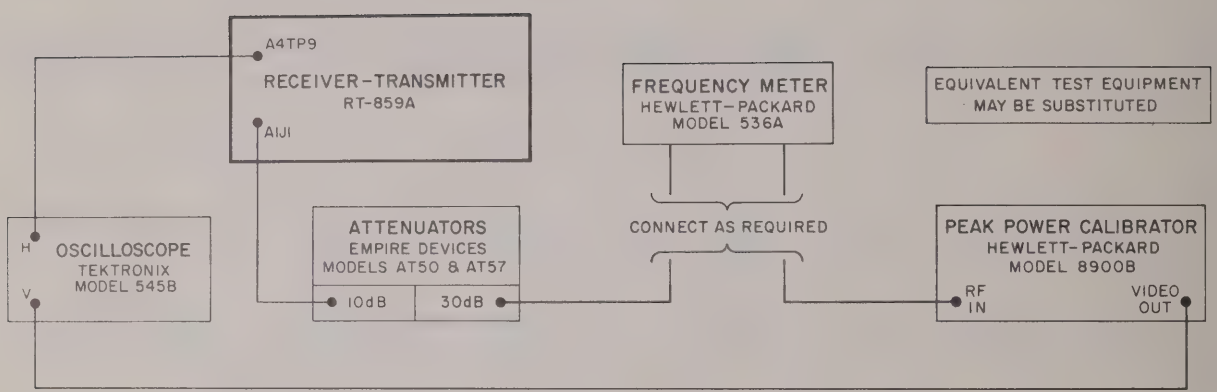
Figure 5-4. Encoder Ring Counter Logic Diagram and Truth Table



NOTE:

CONNECT RECEIVER-TRANSMITTER AND TEST EQUIPMENT TO COMMON GROUND.

TP 5539-1

Figure 5-5. Bench Test Interconnect Diagram for Peak Power and Output Frequency Measurement

ponder and test equipment as described in paragraph 5-4, and check and adjust the coder circuits as follows:

Decoder Multivibrators.

Step 1. Connect a vertical probe of the Tektronix Model 545B Oscilloscope and the Hewlett-Packard Model 5245L Counter in parallel to A4TP9. Connect another vertical probe of 545B to A4TP1.

Step 2. Apply a standard Mode A interrogation signal at -60 dBm to transponder and check that decoder pulses are produced for 100 percent of the interrogations.

Step 3. Alternately decrease input signal level and adjust A4R4 until the maximum number of decoder pulses is 90 percent of those in Step 2. Check that the waveform at A4TP1 is similar to waveform 4 of Figure 5-6.

Step 4. On Tel-Instrument Type T-14A ATC Pulse Generator, vary P3 DELAY control so that spacing of P1 and P3 of the interrogation signal is first 7.8 USEC and then 8.2 USEC. Check that the percentage of decoder pulses at 7.8 USEC and at 8.2 USEC are equal. Return P3 DELAY to center position.

Step 5. Disconnect vertical probe of 545B from A4TP1 and connect it to A4TP4.

Step 6. Apply a back-up Mode A interrogation signal at -60 dBm to transponder and check that decoder pulses are produced for 100 percent of the interrogations.

Step 7. Alternately decrease input signal level and adjust A4R29 until maximum number of decoder pulses is 90 percent of those in Step 6. Check that waveform at A4TP4 is similar to waveform 4 of Figure 5-6.

Step 8. Repeat Step 4.

Step 9. Disconnect vertical probe of 545B from A4TP4 and connect it to A4TP2.

Step 10. Apply a standard Mode C interrogation signal at -60 dBm to transponder and check that decoder pulses are produced for 100 percent of the interrogations.

Step 11. Alternately decrease input signal level and adjust A4R11 until maximum number of decoder pulses is 90 percent of those in Step 10. Check that waveform at A4TP2 is similar to waveform 5 of Figure 5-6.

Step 12. Vary spacing of interrogation pulses P1 and P3 first to 20.8 USEC and then to 21.2 USEC. Check that percentage of decoder pulses at 20.8 USEC and at 21.2 USEC are equal. Set DELAY control to center.

Step 13. Disconnect vertical probe of 545B from A4TP2 and connect it to A4TP5.

Step 14. Apply a back-up Mode C interrogation signal at -60 dBm to transponder and check that decoder pulses are produced for 100 percent of the interrogations.

Step 15. Alternately decrease input signal level and adjust A4R36 until maximum number of decoder pulses is 90 percent of those in Step 14. Check that waveform at A4TP5 is similar to waveform 5 of Figure 5-6.

Step 16. Repeat Step 12.

Step 17. Disconnect vertical probe of 545B from A4TP5 and connect it to A4TP3.

Step 18. Apply a suppressed Mode A interrogation signal at -60 dBm to transponder and check that no decoder pulses are generated at A4TP9. If necessary, adjust A4R21 for no pulses. Check that waveform at A4TP3 is similar to waveform 6 of Figure 5-6.

Step 19. Decrease input signal level until a small percentage of decoder pulses is obtained at A4TP9.

Step 20. Vary spacing of interrogation pulses P1 and P2 first to 1.85 USEC and then to 2.15 USEC. Readjust A4R21 until the percentage of decoder pulses at the two spacings are equal.

Reply Rate Limiter (AOC).

Step 1. Connect the 5245L and a vertical probe of the 545B in parallel to A4TP9.

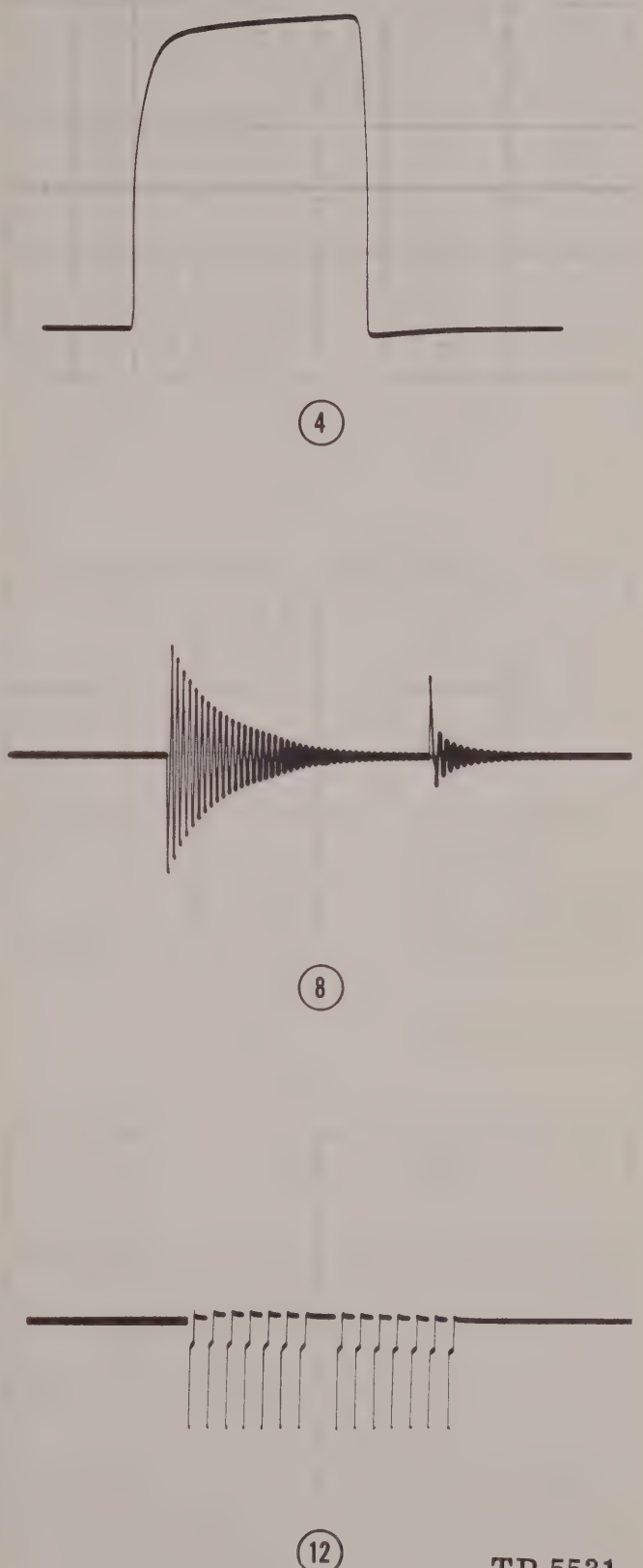
Step 2. Apply a standard Mode interrogation signal at a level 10 dB above MTL and at a rate of 2000 per second.

Step 3. Adjust A4R57 so that decoder pulses are produced at A4TP9 for 60 percent of the interrogations.

Step 4. Increase input signal level to 30 dB above MTL, and check that decoder pulses are produced at A4TP9 for no more than 70 percent of the interrogations.

W

	WAVEFORM	TEST POINT
1	Detected Video Signal	A2A2TP1
2	Pulse-width Discrimination	A2A2Q10
3	Video Signal to Encoder	A2A2-4
4	Output Mode A Multi	A4TP1
	Output Alt. Mode A Multi	A4TP4
5	Output Mode C Multi	A4TP2
	Output Alt. Mode C Multi	A4TP5
6	Output SLS Multi	A4TP3
7	Clock Trigger	A4TP9
8	Clock Sinusoidal Wave	A4TP7
9	Clock Output	A4U9-4
10	Modulator Trigger	A4U9-6
11	Output Modulator Multi	A4TP8
12	Transmitter Input	A4-36



TP 5531

ransponder Waveforms

Step 12. Vary spacing of interrogation pulses P1 and P3 first to 20.8 USEC and then to 21.2 USEC. Check that percentage of decoder pulses at 20.8 USEC and at 21.2 USEC are equal. Set DELAY control to center.

Step 13. Disconnect vertical probe of 545B from A4TP2 and connect it to A4TP5.

Step 14. Apply a back-up Mode C interrogation signal at -60 dBm to transponder and check that decoder pulses are produced for 100 percent of the interrogations.

Step 15. Alternately decrease input signal level and adjust A4R36 until maximum number of decoder pulses is 90 percent of those in Step 14. Check that waveform at A4TP5 is similar to waveform 5 of Figure 5-6.

Step 16. Repeat Step 12.

Step 17. Disconnect vertical probe of 545B from A4TP5 and connect it to A4TP3.

Step 18. Apply a suppressed Mode A interrogation signal at -60 dBm to transponder and check that no decoder pulses are generated at A4TP9. If necessary, adjust A4R21 for no pulses. Check that waveform at A4TP3 is similar to waveform 6 of Figure 5-6.

Step 19. Decrease input signal level until a small percentage of decoder pulses is obtained at A4TP9.

Step 20. Vary spacing of interrogation pulses P1 and P2 first to 1.85 USEC and then to 2.15 USEC. Readjust A4R21 until the percentage of decoder pulses at the two spacings are equal.

Reply Rate Limiter (AOC).

Step 1. Connect the 5245L and a vertical probe of the 545B in parallel to A4TP9.

Step 2. Apply a standard Mode interrogation signal at a level 10 dB above MTL and at a rate of 2000 per second.

Step 3. Adjust A4R57 so that decoder pulses are produced at A4TP9 for 60 percent of the interrogations.

Step 4. Increase input signal level to 30 dB above MTL, and check that decoder pulses are produced at A4TP9 for no more than 70 percent of the interrogations.

WAVEFORM DATA					
WAVEFORM	TEST POINT	OSCILLOSCOPE		INTERROGATION SIGNAL	REPLY CODE
		HORIZ	VERT		
(1) Detected Video Signal	A2A2TP1	2 μs/cm	1 V/cm	Standard Mode A	----
(2) Pulse-width Discrimination	A2A2Q10-E	2 μs/cm	0.5 V/cm	Standard Mode A	----
(3) Video Signal to Encoder	A2A2-4	2 μs/cm	1 V/cm	Standard Mode A	----
(4) Output Mode A Multi	A4TP1	2 μs/cm	1 V/cm	Standard Mode A	----
Output Alt. Mode A Multi	A4TP4	2 μs/cm	1 V/cm	Back-up Mode A	----
(5) Output Mode C Multi	A4TP2	5 μs/cm	1 V/cm	Standard Mode C	----
Output Alt. Mode C Multi	A4TP5	5 μs/cm	1 V/cm	Back-up Mode C	----
(6) Output SLS Multi	A4TP3	2 μs/cm	2 V/cm	Suppressed Mode A	----
(7) Clock Trigger	A4TP9	0.2 ms/cm	1 V/cm	Standard Mode A	----
(8) Clock Sinusoidal Wave	A4TP7	10 μs/cm	2 V/cm	Standard Mode A	----
(9) Clock Output	A4U9-4	10 μs/cm	1 V/cm	Standard Mode A	----
(10) Modulator Trigger	A4U9-6	10 μs/cm	0.5 V/cm	Standard Mode A	0000
(11) Output Modulator Multi	A4TP8	5 μs/cm	5 V/cm	Standard Mode A	7777
(12) Transmitter Input	A4-36	5 μs/cm	50 V/cm	Standard Mode A	7777

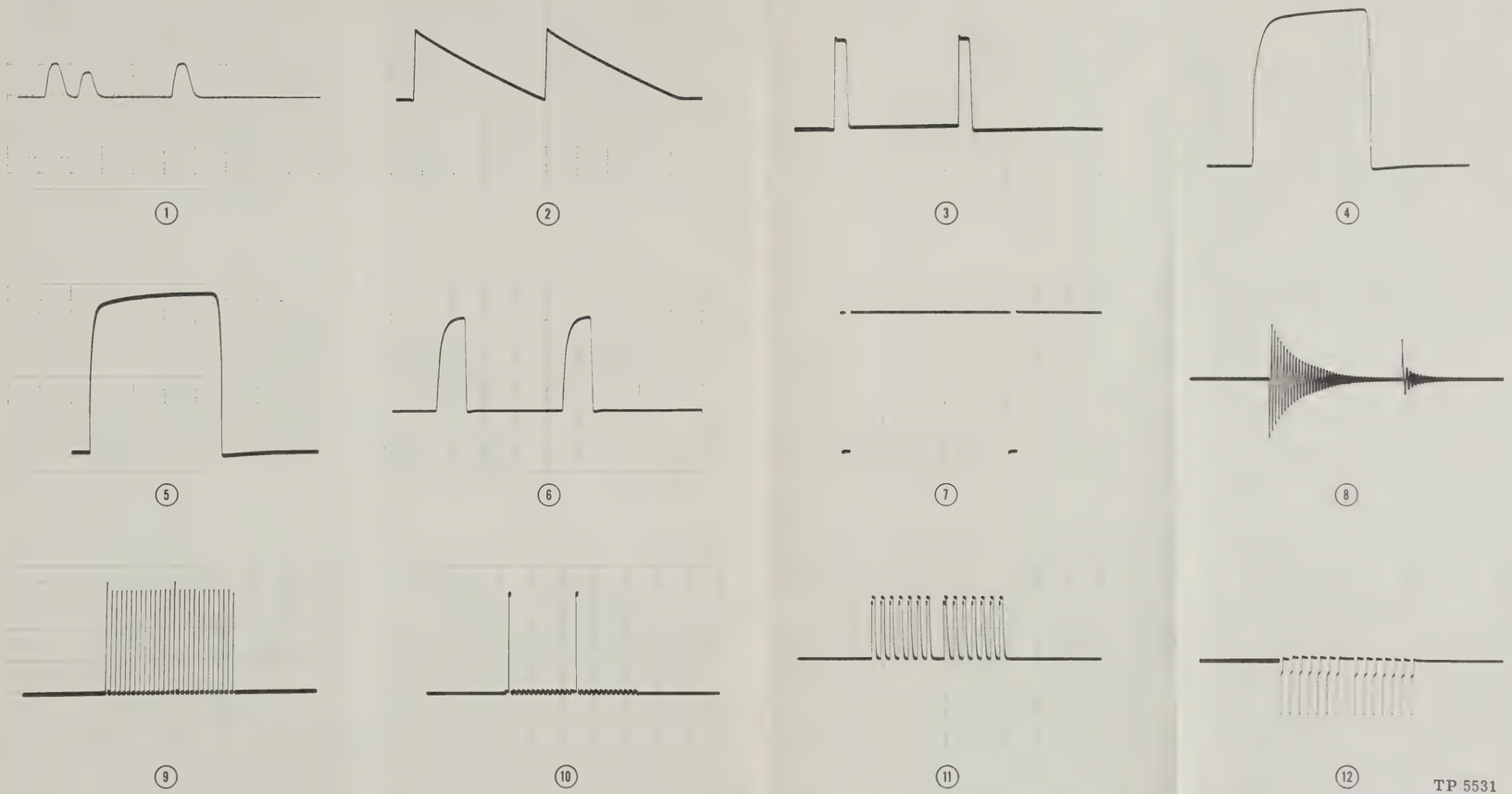


Figure 5-6. Typical Transponder Waveforms

Encoder Reply Pulse Spacing.

Step 1. Connect a vertical input probe of 545B to terminal A4-36. Connect a second probe to MARKER OUTPUT of T-14A.

Step 2. Apply a standard Mode A interrogation signal at a level of -40 dBm, and select Mode A reply code 7700.

Step 3. On T-14A, select MARKER SPACING of 1.45 MFD, and position markers on 545B display so that markers coincide as nearly as possible with transponder output pulses.

Step 4. Adjust A4C21 as necessary for a spacing of 20.3 $\pm$1 MFD between framing pulses F1 and F2. (Refer to Figure 1-2).

Step 5. Momentarily depress ID button and check that IDENT pulse appears 4.35 $\pm$ 0.1 MFD after leading edge of F2.

Step 6. Time duration of IDENT pulse. Duration should be between 15 and 30 seconds.

Encoder Pulse Output.

Step 1. Connect vertical input probe of 545B to terminal A4-36, and apply a standard Mode A interrogation signal at 50 dBm.

Step 2. Refer to paragraph 1-9 and Figure 1-2, and select all Mode A reply pulses cumulatively. Check that each pulse appears in the reply as it is selected (note that F1 and F2 are always present). If any selected pulse does not appear, refer to the logic diagrams for the ring counter (Figure 5-4) and for the information gates (Figure 6-1) to isolate the defective circuit.

Step 3. Push in ALT button, and apply a standard Mode C interrogation signal.

Step 4. Select all Mode C reply pulses cumulatively, and check that each pulse appears in the reply (note that pulses D1 and D2 are not used in a Mode C reply).

Step 5. Release ALT button. Only framing pulses F1 and F2 should appear in the Mode C reply.

Self-Test Circuit.

Step 1. Connect vertical probe of 545B and 5245L in parallel to terminal A4-36.

Step 2. Set test equipment interrogation signal well below transponder MTL, and depress TEST button. Maximum number of transponder replies should be approximately 450 per second.

Step 3. Depress and hold TEST button, and adjust tuning slug of A4L4 to obtain maximum number of replies.

Step 4. Turn transponder off and disconnect all equipment.

5-10. TRANSMITTER PEAK POWER AND FREQUENCY MEASUREMENT.

To measure the transponder peak power and to measure and adjust the transmitter output frequency, interconnect the transponder and test equipment as shown in Figure 5-5, and proceed as follows:

Step 1. Calibrate Hewlett-Packard Model 536A Frequency Meter for 1090 MHz (refer to frequency meter operating instruction manual as necessary), and connect 536A between attenuator output and RF IN of Hewlett-Packard Model 8900B Peak Power Calibrator.

Step 2. Push in ON button, select Mode A reply code 7000, and depress and hold TEST switch.

Step 3. Alternately adjust frequency adjustment screw on cavity oscillator A3 and check output frequency until 536A indicates 1090 $\pm$0.3 MHz.

Step 4. Push in SBY button, and disconnect 536A. Connect attenuator output to RF IN of 8900B.

Step 5. Set 8900B monitor switch to CAL (calibrate). Refer to 8900B instruction manual, and adjust 8900B for a null indication on Tektronix Model 545B Oscilloscope.

Step 6. Set 8900B monitor switch to MEAS (measure); push in ON button, and select Mode A code 7777.

Step 7. After 30 seconds, depress TEST switch and hold it down.

Step 8. Alternately adjust COARSE and FINE controls on 8900B to position horizontal oscilloscope trace at peak of reply pulse trace.

Step 9. Read transponder peak power directly on 8900B. Power should be between 117 and 400 watts. Releast TEST switch.

Step 10. Disconnect vertical input probe of 545B from 8900B VIDEO OUT and connect it to MON/CAL (on back of unit).

Step 11. Set monitor switch to MON/CAL and depress TEST switch.

Step 12. Check that detected transponder output pulses on 545B are between 0.4 and 0.5 USEC wide. If necessary, adjust A4R66 to obtain proper pulse width.

Step 13. Release TEST switch, and push in OFF button. Disconnect all equipment.

SECTION 6

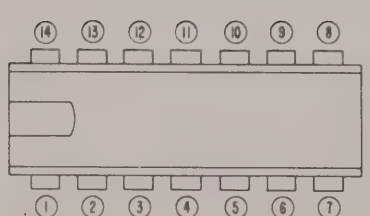
DIAGRAMS

FIGURE		PAGE
6-1	RT-859A Receiver-Transmitter, Schematic Diagram	6-3/6-4
6-2	RT-859A Receiver-Transmitter, Main Wiring Diagram	6-5/6-6
6-3	RT-859A Receiver-Transmitter, A2, Receiver Assembly, Wiring and Part Location Diagram	6-7/6-8
6-4	RT-859A Receiver-Transmitter, A4, Coder Assembly, Wiring and Part Location Diagram	6-9/6-10

INTEGRATED CIRCUITS AND NOTE PAGE FOR FIGURE 6-1. RT-859A RECEIVER-TRANSMITTER, SCHEMATIC DIAGRAM.

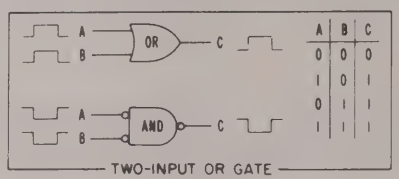
NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX PART DESIGNATION WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION; FOR EXAMPLE, A2A2C1, A4C1.
2. FOR WIRING AND PART LOCATION DIAGRAMS, SEE FIGURES 6-2, 6-3, AND 6-4.
3. CAPACITOR VALUES ARE IN PICOFARADS (pF) UNLESS OTHERWISE NOTED.
4. JUMPER BETWEEN TERMINALS 3 AND 4 OF A4 USED ONLY WHEN CAVITY KIT PART NO. 42257-0250 IS INSTALLED IN THE RECEIVER-TRANSMITTER.
5. INTEGRATED CIRCUIT PIN LOCATIONS AND TYPE NUMBERS ARE IDENTIFIED IN DETAIL A. FOR ALL CIRCUITS EXCEPT A4U3 AND A4U4, PIN 7 IS CONNECTED TO GROUND AND PIN 14 IS CONNECTED TO +5 V BUS; FOR A4U3 AND A4U4, PIN 4 IS CONNECTED TO GROUND AND PIN 11 IS CONNECTED TO +3. 6 V BUS.
6. LOGIC SYMBOLS SHOWN FOR INTEGRATED CIRCUITS ARE DETERMINED BY USE IN CIRCUIT. FOR SYMBOLS AND TRUTH TABLES, SEE DETAIL B.

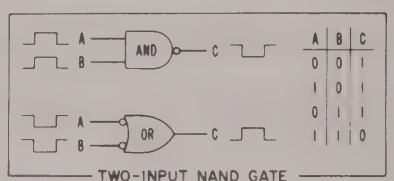


PIN CONNECTIONS, ALL INTEGRATED CIRCUITS

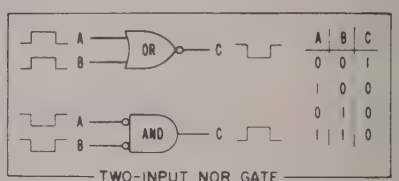
DETAIL A
INTEGRATED CIRCUITS



TWO-INPUT OR GATE

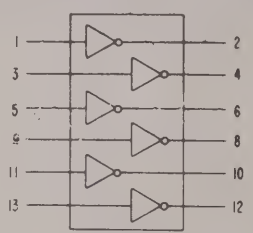


TWO-INPUT NAND GATE

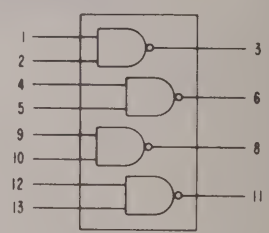


TWO-INPUT NOR GATE

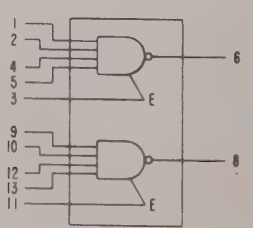
DETAIL B
LOGIC SYMBOLS AND TRUTH TABLES



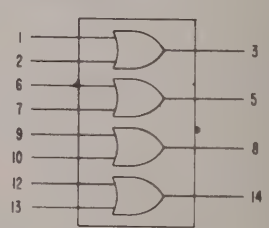
HEX INVERTER
DTL-9936(A4U7)



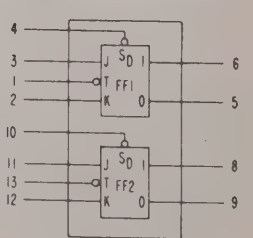
QUAD TWO-INPUT NAND GATE
DTL-9946(A4U1, A4U8, A4U22, A4U23)
SN-7400(A4U2, A4U6)
DTL-9949(A4U5)



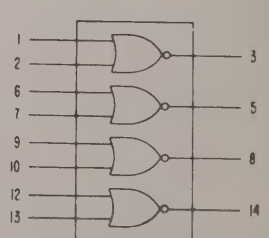
BUFFER
DTL-9932(A4U9).
DUAL FOUR-INPUT NAND GATE
DTL-9930(A4U15-A4U21)



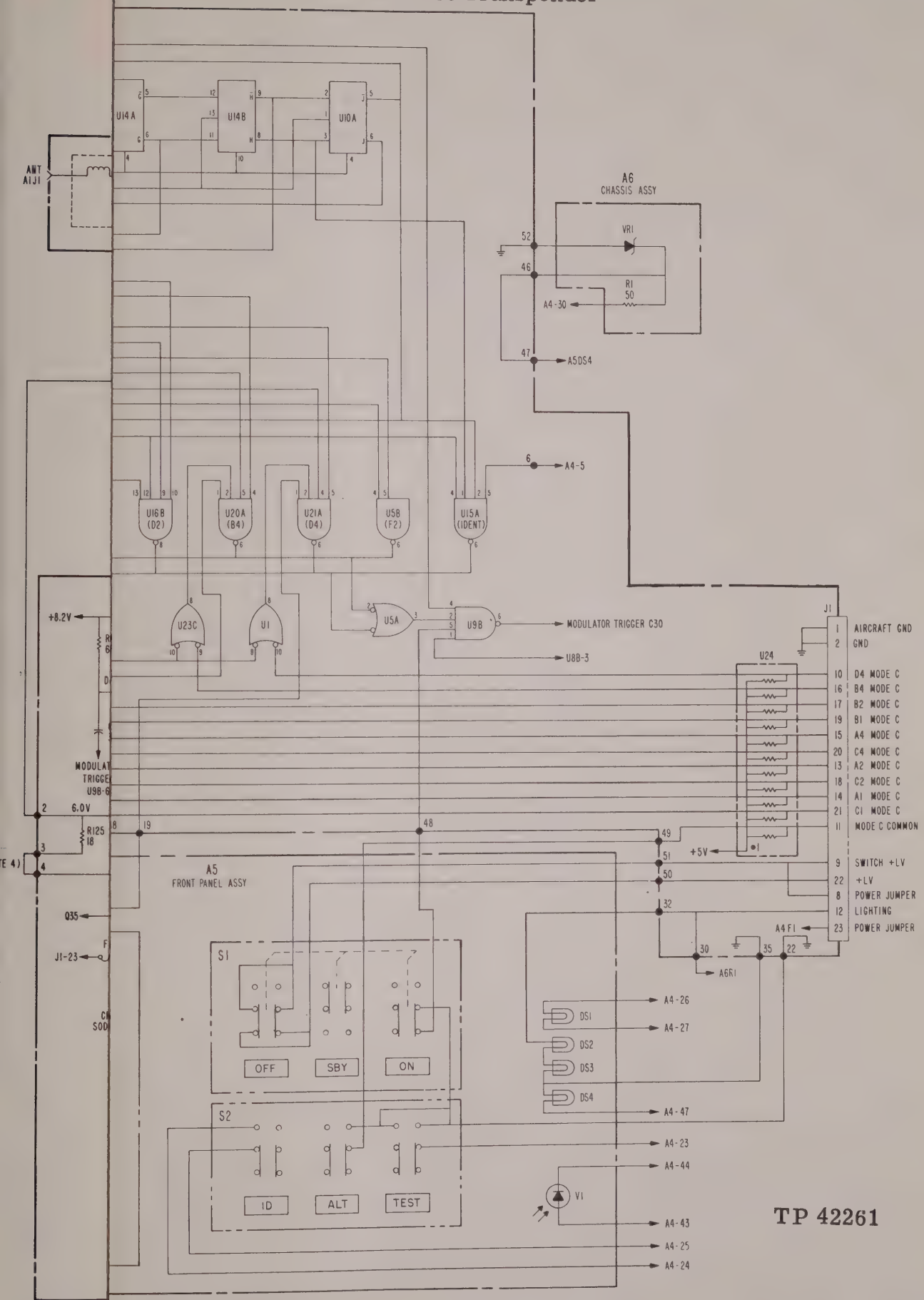
QUAD TWO-INPUT OR GATE
MC9815P(A4U3)



DUAL JK FLIP-FLOP
DTL-9093(A4U10-A4U14)



QUAD TWO-INPUT NOR GATE
MC824P(A4U4)



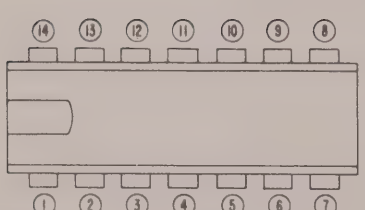
TP 42261

6-1. RT-859A Receiver-Transmitter, Schematic Diagram

INTEGRATED CIRCUITS AND NOTE PAGE FOR FIGURE 6-1. RT-859A RECEIVER-TRANSMITTER, SCHEMATIC DIAGRAM.

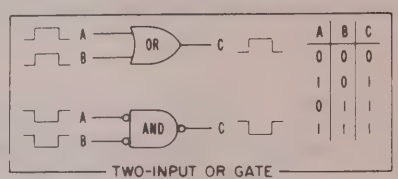
NOTES:

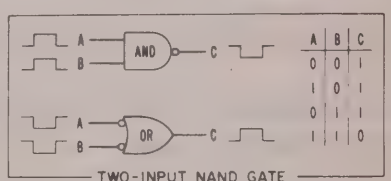
1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX PART DESIGNATION WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION; FOR EXAMPLE, A2A2C1, A4C1.
2. FOR WIRING AND PART LOCATION DIAGRAMS, SEE FIGURES 6-2, 6-3, AND 6-4.
3. CAPACITOR VALUES ARE IN PICOFARADS (pF) UNLESS OTHERWISE NOTED.
4. JUMPER BETWEEN TERMINALS 3 AND 4 OF A4 USED ONLY WHEN CAVITY KIT PART NO. 42257-0250 IS INSTALLED IN THE RECEIVER-TRANSMITTER.
5. INTEGRATED CIRCUIT PIN LOCATIONS AND TYPE NUMBERS ARE IDENTIFIED IN DETAIL A. FOR ALL CIRCUITS EXCEPT A4U3 AND A4U4, PIN 7 IS CONNECTED TO GROUND AND PIN 14 IS CONNECTED TO +5 V BUS; FOR A4U3 AND A4U4, PIN 4 IS CONNECTED TO GROUND AND PIN 11 IS CONNECTED TO +3. 6 V BUS.
6. LOGIC SYMBOLS SHOWN FOR INTEGRATED CIRCUITS ARE DETERMINED BY USE IN CIRCUIT. FOR SYMBOLS AND TRUTH TABLES, SEE DETAIL B.

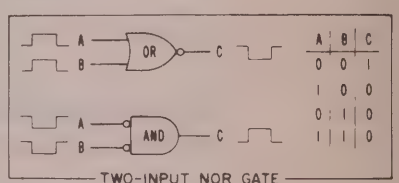


PIN CONNECTIONS, ALL INTEGRATED CIRCUITS

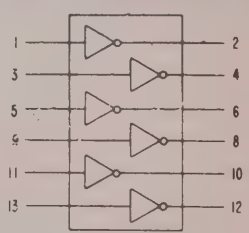
DETAIL A
INTEGRATED CIRCUITS



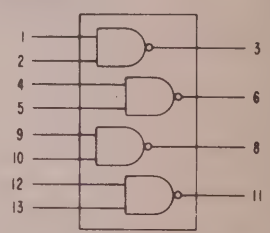




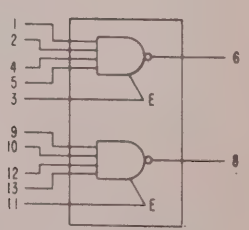
DETAIL B
LOGIC SYMBOLS AND TRUTH TABLES



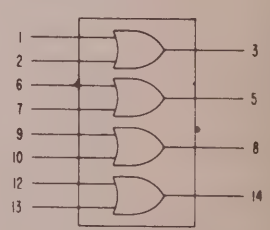
HEX INVERTER
DTL-9936(A4U7)



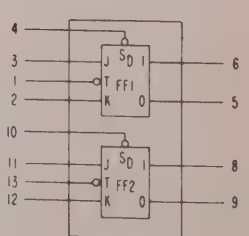
QUAD TWO-INPUT NAND GATE
DTL-9946(A4U1, A4U8, A4U22, A4U23)
SN-7400(A4U2, A4U6)
DTL-9949(A4U5)



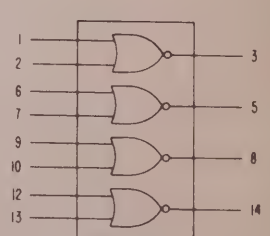
BUFFER
DTL-9932(A4U9).
DUAL FOUR-INPUT NAND GATE
DTL-9930(A4U15-A4U21)



QUAD TWO-INPUT OR GATE
MC9815P(A4U3)



DUAL JK FLIP-FLOP
DTL-9093(A4U10-A4U14)



QUAD TWO-INPUT NOR GATE
MC824P(A4U4)

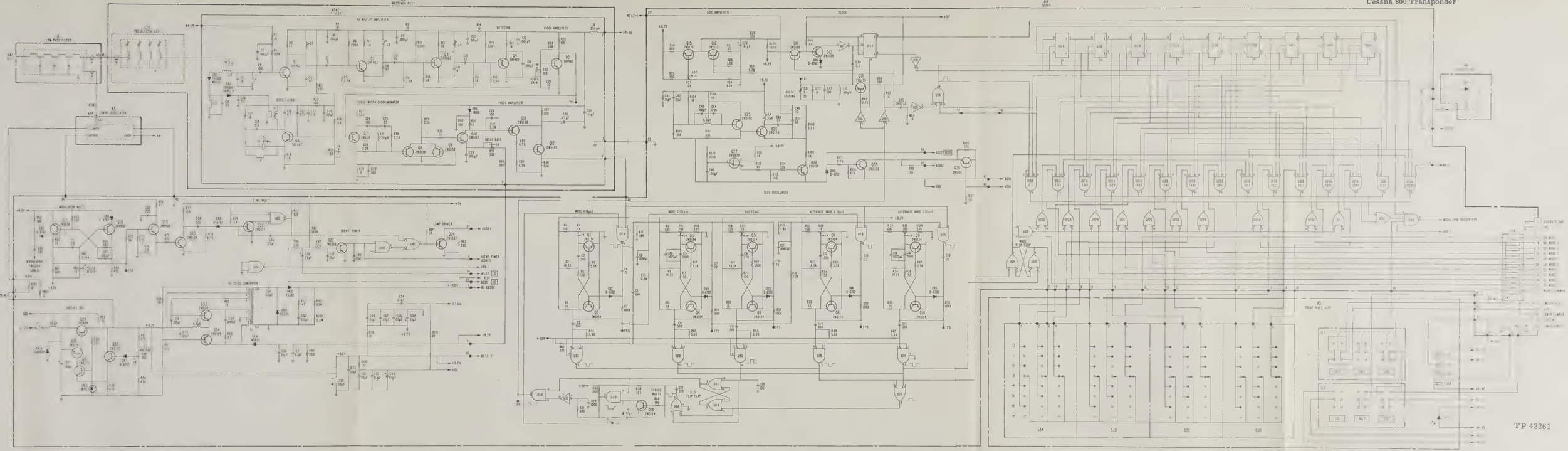
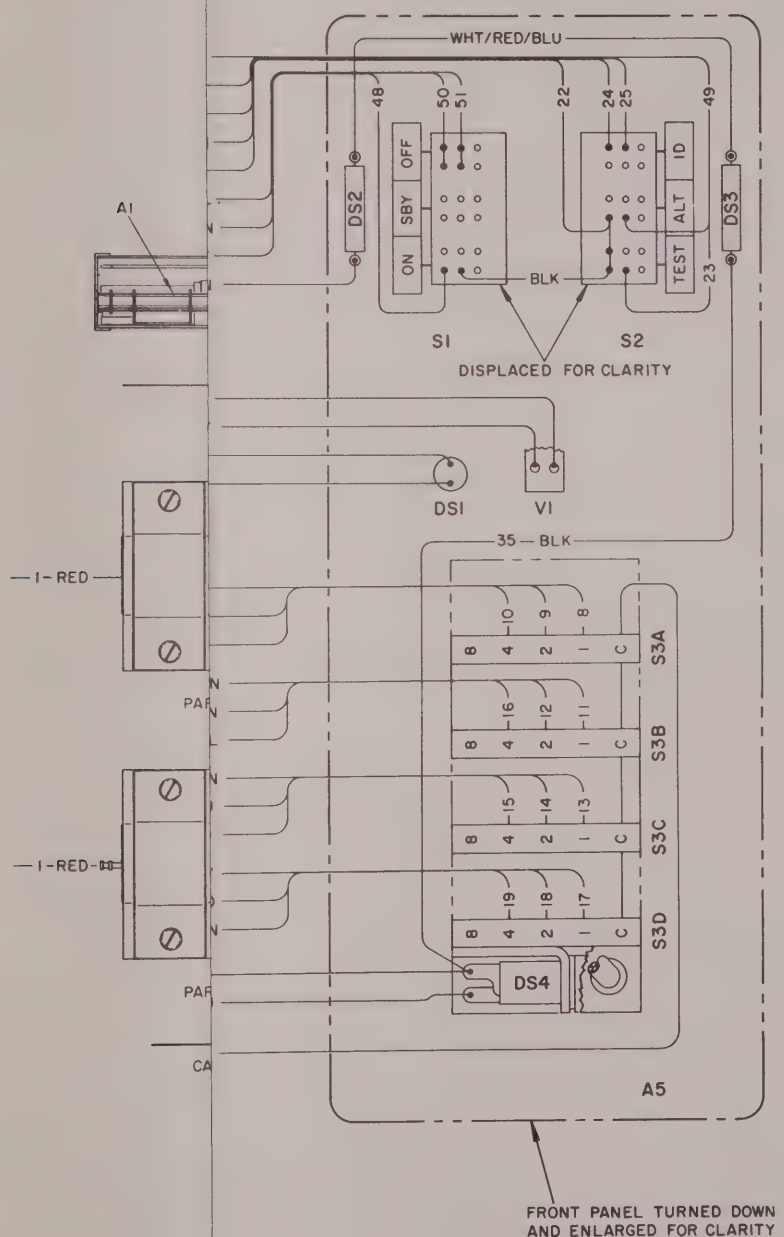


Figure 6-1. RT-859A Receiver-Transmitter, Schematic Diagram

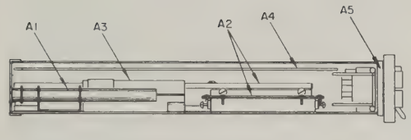


NOTES:

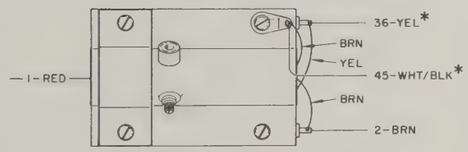
1. REFERENCE DESIGNATIONS FOR ASSEMBLY A5 ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX PART DESIGNATION WITH ASSEMBLY DESIGNATION; FOR EXAMPLE, A5R1.
2. TO COMPLETE RECEIVER-TRANSMITTER WIRING AND PART LOCATION DIAGRAM, SEE FIGURES 6-3 AND 6-4.
3. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
4. SHADED AREA ON ASSEMBLY A4 IS PRINTED WIRING ON COMPONENT SIDE OF BOARD.
5. FOR CLARITY, ASSEMBLIES A4 AND A5 ARE DISPLACED AND A5 IS TURNED DOWN. FOR ACTUAL ASSEMBLY LOCATION, SEE LOCATION DETAIL.
6. ALL WIRES ARE STRANDED COPPER, TEFLON INSULATED. WIRES MARKED WITH COLOR NOTE ONLY ARE NO. 26 AWG; THOSE MARKED WITH COLOR NOTE ASTERISK (*) ARE NO. 22 AWG. NUMBERS ADJACENT TO COLOR NOTE REFER TO TERMINAL NUMBERS ON A4.
7. JUMPER BETWEEN A4 TERMINALS 3 AND 4 USED ONLY WHEN CAVITY KIT PART NO. 42257-0250 IS INSTALLED.

TP 5533

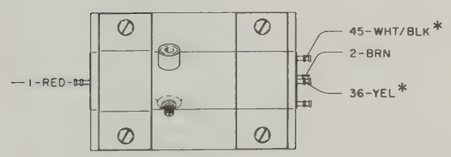
er-Transmitter, Main Wiring Diagram



LOCATION OF ASSEMBLIES



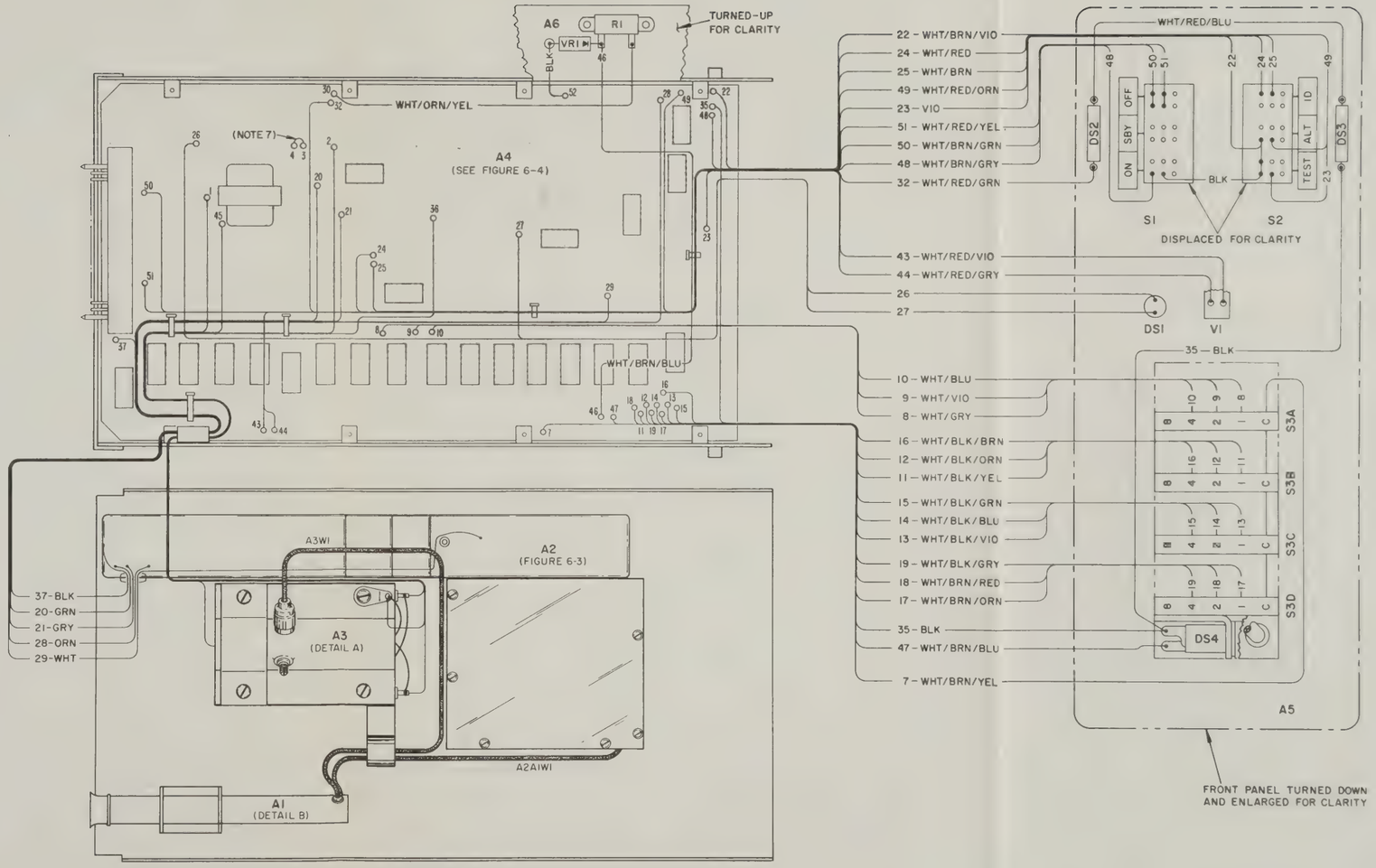
PART NO. 42256-0250



PART NO. 42257-0250

DETAIL A
CAVITY KIT WIRING

DETAIL B
LOW-PASS FILTER WIRING



NOTES:

1. REFERENCE DESIGNATIONS FOR ASSEMBLY A5 ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX PART DESIGNATION WITH ASSEMBLY DESIGNATION; FOR EXAMPLE, A5R1.
2. TO COMPLETE RECEIVER-TRANSMITTER WIRING AND PART LOCATION DIAGRAM, SEE FIGURES 6-3 AND 6-4.
3. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
4. SHADED AREA ON ASSEMBLY A4 IS PRINTED WIRING ON COMPONENT SIDE OF BOARD.
5. FOR CLARITY, ASSEMBLIES A4 AND A5 ARE DISPLACED AND A5 IS TURNED DOWN. FOR ACTUAL ASSEMBLY LOCATION, SEE LOCATION DETAIL.
6. ALL WIRES ARE STRANDED COPPER, TEFLON INSULATED. WIRES MARKED WITH COLOR NOTE ONLY ARE NO. 26 AWG; THOSE MARKED WITH COLOR NOTE ASTERISK (*) ARE NO. 22 AWG. NUMBERS ADJACENT TO COLOR NOTE REFER TO TERMINAL NUMBERS ON A4.
7. JUMPER BETWEEN A4 TERMINALS 3 AND 4 USED ONLY WHEN CAVITY KIT PART NO. 42257-0250 IS INSTALLED.

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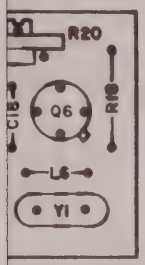
Figure 6-2. RT-859A Receiver-Transmitter, Main Wiring Diagram



NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX PART DESIGNATION WITH ASSEMBLY AND SUB-ASSEMBLY DESIGNATIONS; FOR EXAMPLE, A2A2C1.
2. FOR MAIN WIRING DIAGRAM, SEE FIGURE 6-2.
3. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
4. PRINTED WIRING ASSEMBLY A2A2 DISPLACED FOR CLARITY.
5. PRINTED WIRING ON OPPOSITE SIDE OF A2A2 IS SHOWN AS SHADED AREA.
6. A2A2C26 SHOWN BY BROKEN LINES IS LOCATED ON OPPOSITE SIDE OF BOARD.
7. A2A1, INCLUDING A2A1W1, IS NOT REPAIRABLE.

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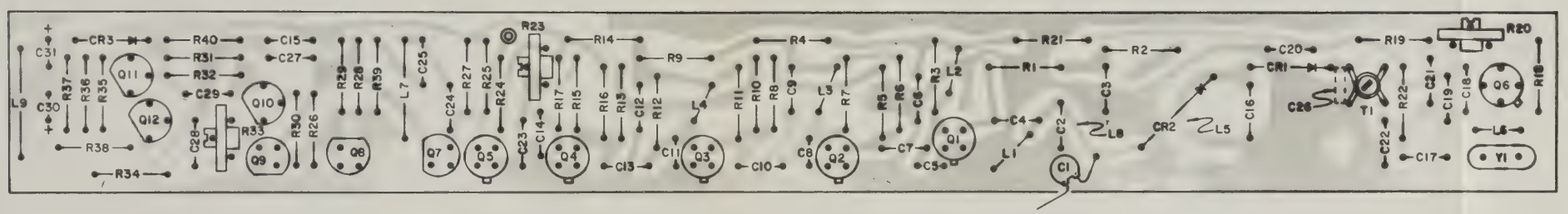
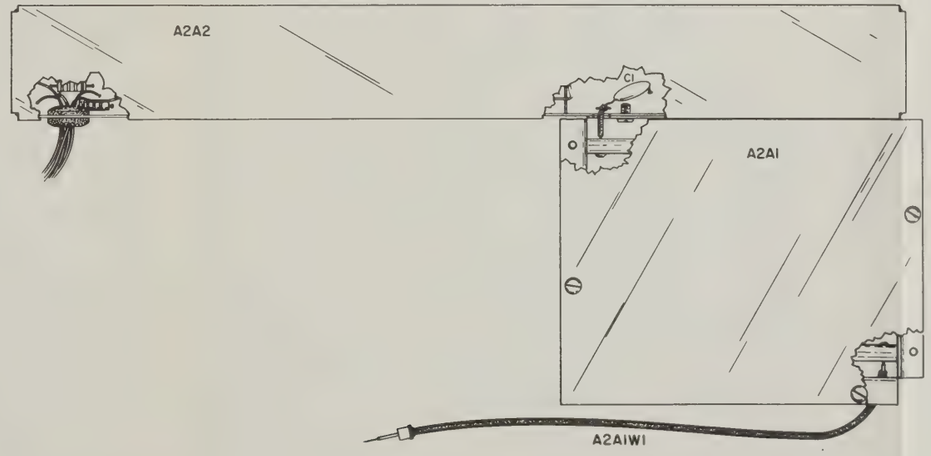
er Assembly, Wiring and Part Location Diagram



—— PRINTED WIRING ASSEMBLY, DISPLACED FOR CLARITY ——



NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX PART DESIGNATION WITH ASSEMBLY AND SUB-ASSEMBLY DESIGNATIONS; FOR EXAMPLE, A2A2C1.
2. FOR MAIN WIRING DIAGRAM, SEE FIGURE 6-2.
3. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
4. PRINTED WIRING ASSEMBLY A2A2 DISPLACED FOR CLARITY.
5. PRINTED WIRING ON OPPOSITE SIDE OF A2A2 IS SHOWN AS SHADED AREA.
6. A2A2C26 SHOWN BY BROKEN LINES IS LOCATED ON OPPOSITE SIDE OF BOARD.
7. A2A1, INCLUDING A2A1W1, IS NOT REPAIRABLE.

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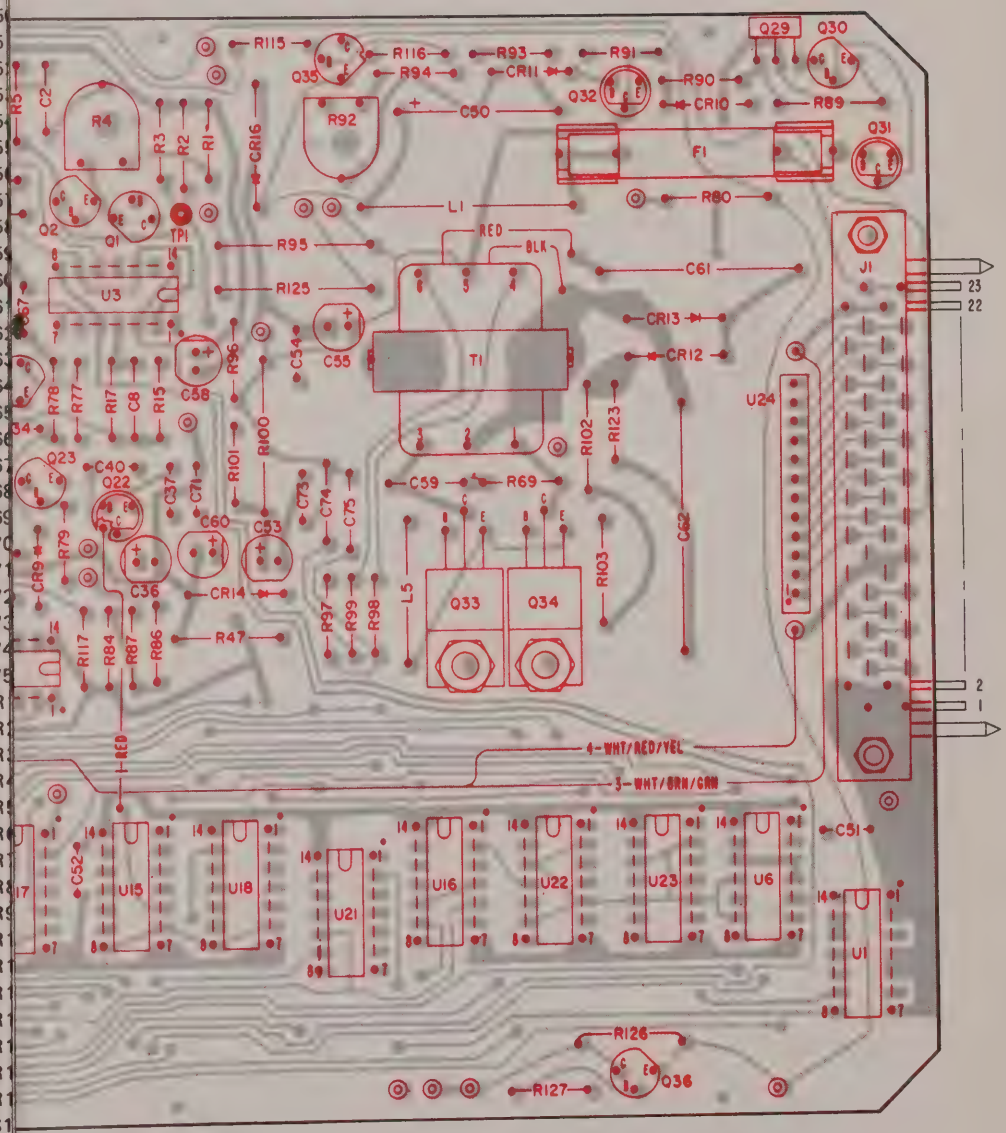
Figure 6-3. RT-859A Receiver-Transmitter, A2, Receiver Assembly, Wiring and Part Location Diagram

TED WIRING IS SHOWN AS
ED AREA.

PONENTS SHOWN IN RED ARE
TED ON UNDERSIDE OF
D (AS VIEWED).

DESIG	LOC	DES
C1	5A	C4
C2	4A	C5
C3	4A	C5
C4	5A	C5
C5	6A	C5
C6	6A	C5
C7	6A	C5
C8	4B	C5
C9	7A	C5
C10	7A	C5
C11	7A	C5
C12	6B	C6
C13	5A	C6
C14	5B	C6
C15	5B	C6
C16	7B	C6
C17	7B	C6
C18	7A	C6
C19	7B	C6
C20	6B	C6
C21	6B	C6
C22	6B	C7
C23	6B	C7
C24	7B	C7
C25	7B	C7
C26	7B	C7
C27	8B	C7
C28	8B	CR
C29	6C	CR
C30	6C	CR
C31	5C	CR
C32	5B	CR
C33	5C	CR
C34	4B	CR
C35	4C	CR
C36	4C	CR
C37	4C	CR
C38	–	CR
C39	–	CR
C40	4C	CR
C41	7C	CR
C42	8C	CR
C43	8C	CR
C44	8D	DS1
C45	6A	DS2
C46	7C	DS3
C47	8C	F1
C48	8C	J1



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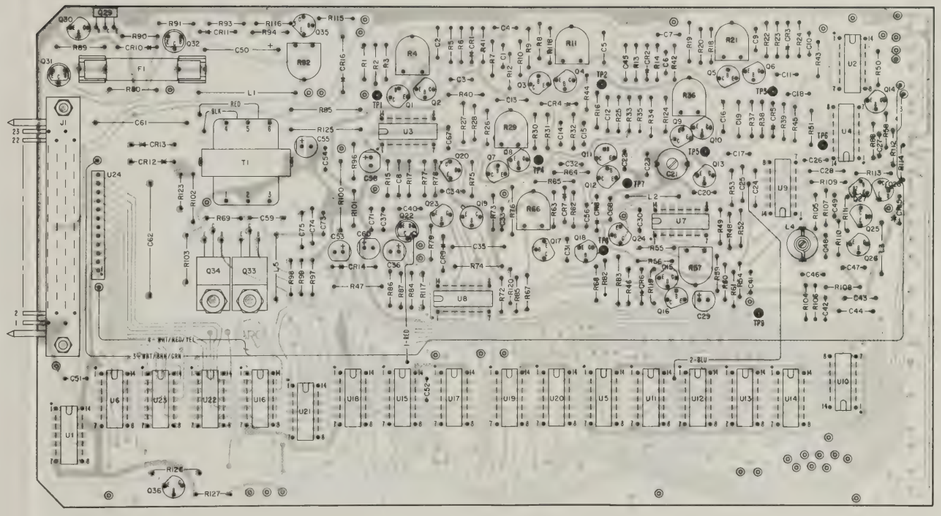
Wiring and Part Location Diagram

PART LOCATION INDEX

DESIG	LOC	DESIG	LOC	DESIG	LOC	DESIG	LOC	DESIG	LOC	DESIG	LOC
C1	5A	C49	8B	L1	2A	R9	5A	R57	6C	R105	7C
C2	4A	C50	2A	L2	6B	R10	5A	R58	8B	R106	7C
C3	4A	C51	1D	L3	8C	R11	5A	R59	7C	R107	8C
C4	5A	C52	4D	L4	7C	R12	5A	R60	7C	R108	8C
C5	6A	C53	3C	L5	3C	R13	6A	R61	7C	R109	8B
C6	6A	C54	3B	Q1	4A	R14	6A	R62	5C	R110	8C
C7	6A	C55	3B	Q2	4A	R15	4B	R63	5C	R111	8C
C8	4B	C56	5C	Q3	5A	R16	5B	R64	5B	R112	8B
C9	7A	C57	–	Q4	5A	R17	4B	R65	5B	R113	8B
C10	7A	C58	3B	Q5	7A	R18	7A	R66	5C	R114	8B
C11	7A	C59	3C	Q6	7A	R19	6A	R67	5C	R115	3A
C12	6B	C60	3C	Q7	5B	R20	6A	R68	5C	R116	3A
C13	5A	C61	1B	Q8	5B	R21	7A	R69	2C	R117	4C
C14	5B	C62	1C	Q9	6B	R22	7A	R70	–	R118	5A
C15	5B	C63	–	Q10	6B	R23	7A	R71	–	R119	6C
C16	7B	C64	–	Q11	6B	R24	7A	R72	5C	R120	5C
C17	7B	C65	–	Q12	6B	R25	6B	R73	5C	R121	–
C18	7A	C66	–	Q13	6B	R26	5B	R74	4C	R122	–
C19	7B	C67	4B	Q14	8A	R27	4B	R75	4B	R123	2B
C20	6B	C68	6C	Q15	6C	R28	4B	R76	5C	R124	6B
C21	6B	C69	–	Q16	6C	R29	5B	R77	4B	R125	3B
C22	6B	C70	–	Q17	5C	R30	5B	R78	4B	R126	2E
C23	6B	C71	3C	Q18	5C	R31	5B	R79	4C	R127	2E
C24	7B	C72	–	Q19	4C	R32	5B	R80	1A	T1	2B
C25	7B	C73	3C	Q20	4B	R33	6B	R81	–	U1	1E
C26	7B	C74	3C	Q22	4C	R43	6B	R82	6C	U2	8A
C27	8B	C75	3C	Q23	4C	R35	6B	R83	6C	U3	4B
C28	8B	CR1	4A	Q24	6C	R36	6A	R84	4C	U4	8B
C29	6C	CR2	6A	Q25	8C	R37	7B	R85	5C	U5	6D
C30	6C	CR3	7A	Q26	8C	R38	7B	R86	4C	U6	1D
C31	5C	CR4	5A	Q27	8B	R39	7B	R87	4C	U7	6C
C32	5B	CR5	7B	Q28	8B	R40	4A	R88	8B	U8	4C
C33	5C	CR6	6C	Q29	1A	R41	4A	R89	1A	U9	7B
C34	4B	CR7	5C	Q30	1A	R42	6A	R90	1A	U10	8D
C35	4C	CR8	5C	Q31	1A	R43	7A	R91	2A	U11	6D
C36	4C	CR9	4C	Q32	2A	R44	5A	R92	3A	U12	6D
C37	4C	CR10	1A	Q33	2C	R45	7B	R93	2A	U13	7D
C38	–	CR11	2A	Q34	2C	R46	6C	R94	3A	U14	7D
C39	–	CR12	2B	Q35	3A	R47	3C	R95	3B	U15	4D
C40	4C	CR13	2B	Q36	1E	R48	7C	R96	3B	U16	2D
C41	7C	CR14	3C	R1	3A	R49	7C	R97	3C	U17	4D
C42	8C	CR15	8C	R2	4A	R50	8A	R98	3C	U18	3D
C43	8C	CR16	3A	R3	4A	R51	7B	R99	3C	U19	5D
C44	8D	DS1	8A	R4	4A	R52	7C	R100	3B	U20	5D
C45	6A	DS2	8E	R5	4A	R53	7B	R101	3B	U21	3E
C46	7C	DS3	8C	R6	4A	R54	7C	R102	2B	U22	2D
C47	8C	F1	1A	R7	5A	R55	6C	R103	2C	U23	2D
C48	8C	J1	1B	R8	5A	R56	6C	R104	7C	U24	1B

NOTES:

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. FOR COMPLETE IDENTIFICATION, PREFIX PART DESIGNATION WITH ASSEMBLY DESIGNATION; FOR EXAMPLE, A4C1.
2. FOR MAIN WIRING DIAGRAM, SEE FIGURE 6-2.
3. FOR SCHEMATIC DIAGRAM, SEE FIGURE 6-1.
4. PRINTED WIRING IS SHOWN AS SHADED AREA.
5. COMPONENTS SHOWN IN RED ARE LOCATED ON UNDERSIDE OF BOARD (AS VIEWED).



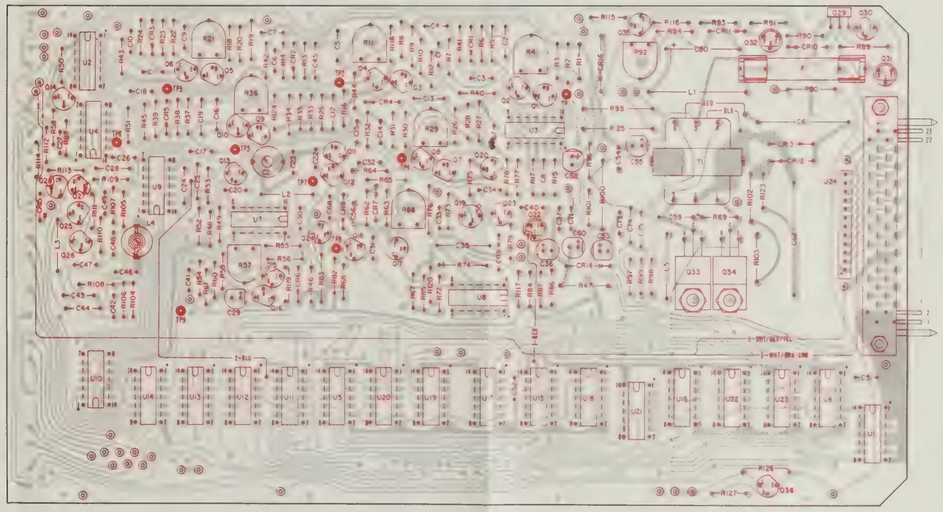


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Figure 6-4. RT-859A Receiver-Transmitter, A4, Coder Assembly, Wiring and Part Location Diagram

SECTION 7

PARTS LISTS

This section lists and describes the replaceable electrical parts for the 859A ATC Transponder. The parts are listed in an alphabetical-numerical sequence of the reference designations assigned to the parts on the schematic diagram included in Section 6. The reference designations as listed are abbreviated; for the complete designation, prefix the designation included at the beginning of each assembly parts list. For example, the complete reference designation for capacitor C1 in A4 would be A4C1.

With each assembly parts list, complete information is given for a part listed for the first time. Subsequent listings of the same part within the same assembly are referred back to the original listing. ARC part numbers are listed in a separate column in the parts lists. Other manufacturer's part numbers are identified by the individual manufacturer's numerical code (as listed in the Federal Supply Code for Manufacturers, H4-2) and the manufacturer's part number, both of which are listed in a separate column. The numerical codes used in the parts lists and the related names and addresses of the manufacturers are as follows:

Code	Name and Address
00779	AMP, Inc. P. O. Box 3608 Harrisburg, Penn. 17105
01121	Allen-Bradley Company 1201 South 2nd Street Milwaukee, Wisconsin 53204
01295	Texas Instruments, Inc. Semiconductor-Components Div. 13500 N. Central Expressway Dallas, Texas 75231
03508	General Electric Company Semiconductor Products Dept. Electronics Park Syracuse, New York 13201
04713	Motorola Semiconductor Products, Incorporated 5005 E. McDowell Road Phoenix, Arizona 85008
07263	Fairchild Camera & Instrument Corp. Semiconductor Division 313 Frontage Road Mountain View, Calif. 94041
13327	Solictron Devices, Inc. 256 Oak Tree Road Tappan, New York 10983
14655	Cornell-Dubilier Electric Corp. 50 Paris Street Newark, New Jersey 07105

Cessna 800 Transponder

Code	Name and Address
17803	Fairchild Camera & Instrument Corporation Semiconductor Division 423 National Drive Mountain View, Calif. 94041
24176	Teledyne, Inc. 1525 S. Daphne Avenue Hawthorne, Calif. 90250
56289	Sprague Electric Co. 367 Marshall Street North Adams, Mass. 01247
71744	Chicago Miniature Lamp Works 4433 Ravenswood Avenue Chicago, Illinois 60640
72136	Electro Motive Mfg. Co., Inc. South Park & John Streets Willimantic, Conn. 06226
72699	General Instrument Corp. 65 Gouverneur Street Newark, New Jersey 07104
72982	Erie Technological Products 644 West 12th Street Erie, Penn. 16512
73445	Amperex Electronic Corp. 230 Duffy Avenue Hicksville, New York 11801
75042	IRC, Inc. 401 North Broad Street Philadelphia, Penn. 19108
76055	Mallory Controls Div. of P.R. Mallory Co., Inc. State Road 28 W Frankfort, Indiana 46041
79089	RCA Solid State & Receiving Tube Div. 415 South 5th Street Harrison, New Jersey 07029
80294	Bourns, Inc. 1200 Columbia Avenue Riverside, Calif. 95207
81073	Grayhill, Inc. 561 Hillgrove Avenue La Grange, Illinois 60525
81483	International Rectifier Corp. 233 Kansas Street El Segundo, Calif. 90245
89870	Berkshire Transformer Corp. Kent, Connecticut 06757
91637	Dale Electronics, Inc. P.O. Box 609 Columbus, Nebraska 68601
93332	Sylvania Electric Products, Inc. Semiconductor Products Division 100 Sylvan Road Woburn, Mass. 01801

RT-859A RECEIVER-TRANSMITTER PARTS LIST

Reference Des.	Description	Part No.	Manufacturer & Part No.
	FILTER ASSEMBLY, A1 (Part No. 42109)		
	Note The detail parts of this assembly are nonprocurable.		
	RECEIVER ASSEMBLY , A2 (Part No. 42265)		
	PRESELECTOR ASSEMBLY, A2A1 (Part No. 42137)		
	Note The detail parts of this assembly are nonprocurable.		
	IF ASSEMBLY, A2A2 (Part No. 42107)		
C1	CAPACITOR, Fixed, ceramic, 2.2 pF ±5%, 500 Vdc	27696-9221	
C2	CAPACITOR, Fixed, ceramic, 18 pF ±5%, 500 Vdc	27696-0180	
C3	CAPACITOR, Fixed, ceramic, 1000 pF ±10%, 200 Vdc	28448-0102	72982 X5F
C4	CAPACITOR, Fixed, ceramic, 100 pF ±10%, 200 Vdc	28448-0101	72982 X5F
C5	CAPACITOR, Fixed, mica, 47 pF ±5%, 100 Vdc	36245-0470	72136 DM10 (4CR)
C6	Same as C3		
C7	CAPACITOR, Fixed, ceramic, 15 pF ±5%, 500 Vdc	27696-0150	
C8	Same as C5		
C9	Same as C3		
C10	Same as C7		
C11	Same as C5		
C12	Same as C3		
C13	Same as C7		
C14	Same as C3		
C15	Same as C3		
C16	CAPACITOR, Fixed, ceramic, 8.2 ±5 pF, 500 Vdc	42232	72982 310
C17	Same as C2		
C18	CAPACITOR, Fixed, ceramic, 5.6 pF ±5%, 500 Vdc	27696-9561	
C19	CAPACITOR, Fixed, ceramic, 4.7 pF ±5%, 500 Vdc	27696-9471	
C20	Same as C3		
C21	CAPACITOR, Fixed, ceramic, 270 pF ±10%, 200 Vdc	28448-0271	72982 X5F
C22	Same as C21		
C23	CAPACITOR, Fixed, mica, 39 pF ±5%, 500 Vdc	32134-0390	
C24	Same as C4		
C25	CAPACITOR, Fixed, ceramic, 22 pF ±5%, 500 Vdc	27696-0220	
C26	CAPACITOR, Fixed, ceramic, 2.2 ±0.25 pF, 50 Vdc	42748-0000	
C27	Same as C4		
C28	Same as C3		
C29	CAPACITOR, Fixed, ceramic, 150 pF ±10%, 200 Vdc	28448-0151	72982 X5F
C30	CAPACITOR, Fixed, tantalum, 0.47 MFD ±10%, 35 Vdc	40248-1059	56289 196D
C31	CAPACITOR, Fixed, tantalum, 33 MFD ±10%, 15 Vdc	40248-2518	56289 196D
CR1	DIODE, Tripler	42143-0000	24176 CD6585
CR2	DIODE, Mixer	42144-0000	17803 FH 1100
CR3	DIODE, Silicon	32433-0005	01295 1N916

RT-859A RECEIVER-TRANSMITTER PARTS LIST - Continued

Reference Des.	Description	Part No.	Manufacturer & Part No.
	IF ASSEMBLY, A2A2 (Part No. 42107) - Continued		
L1	COIL, RF	42752-0000	
L2	COIL, RF	42123-0001	
L3	Same as L2		
L4	Same as L2		
L5	Part of Printed Circuit Board (Part No. 42108)		
L6	COIL, RF	42123-0002	
L7	INDUCTOR, RF, shielded	34614-0221	
L8	Part of Printed Circuit Board (Part No. 42108)		
L9	INDUCTOR, RF, shielded	34614-0331	
Q1	TRANSISTOR	42269	04713 SRF462
Q2-Q6	Same as Q1		
Q7	TRANSISTOR	41123-0021	17803 2N5133
Q8	TRANSISTOR	41123-0023	17803 2N5138
Q9	Same as Q8		
Q10	Same as Q7		
Q11	Same as Q8		
Q12	Same as Q7		
R1	RESISTOR, Fixed, comp, 100,000 ohms ±10%, 1/4 W	200-0104	01121 CB1041
R2	RESISTOR, Fixed, comp, 1000 ohms ±10%, 1/4 W	200-0102	01121 CB1021
R3	Same as R2		
R4	RESISTOR, Fixed, comp, 10 ohms ±10%, 1/4 W	200-0100	01121 CB1001
R5	RESISTOR, Fixed, comp, 2700 ohms ±10%, 1/4 W	200-0272	01121 CB272
R6	RESISTOR, Fixed, comp, 220,000 ohms ±10%, 1/4 W	200-0224	01121 CB2241
R7	Same as R2		
R8	Same as R5		
R9	Same as R4		
R10	Same as R2		
R11	Same as R6		
R12	Same as R2		
R13	Same as R2		
R14	Same as R4		
R15	RESISTOR, Fixed, comp, 3300 ohms ±10%, 1/4 W	200-0332	01121 CB3321
R16	Same as R6		
R17	Same as R2		
R18	Same as R2		
R19	RESISTOR, Fixed, comp, 15,000 ohms ±10%, 1/4 W	200-0153	01121 CB1531
R20	RESISTOR, Variable, 10,000 ohms ±20%, 3/4 W	40878-1103	80294 3359W
R21	RESISTOR, Fixed, comp, 100 ohms ±10%, 1/4 W	200-0101	01121 CB1011
R22	Same as R21		
R23	Same as R20		
R24	RESISTOR, Fixed, comp, 56,000 ohms ±10%, 1/4 W	200-0563	01121 CB5631
R25	RESISTOR, Fixed, comp, 10,000 ohms ±10%, 1/4 W	200-0103	01121 CB1031
R26	Same as R2		
R27	RESISTOR, Fixed, comp, 1200 ohms ±10%, 1/4 W	200-0122	01121 CB1221
R28	RESISTOR, Fixed, comp, 2200 ohms ±10%, 1/4 W	200-0222	01121 CB2221
R29	RESISTOR, Fixed, comp, 3300 ohms ±10%, 1/4 W	200-0332	01121 CB3321
R30	Same as R2		
R31	Same as R2		
R32	Same as R28		
R33	RESISTOR, Variable, 50,000 ohms ±20%, 3/4 W	40878-1473	80294 3359W
R34	RESISTOR, Fixed, comp, 39,000 ohms ±10%, 1/4 W	200-0393	01121 CB3931

RT-859A RECEIVER-TRANSMITTER PARTS LIST - Continued

Reference Des.	Description	Part No.	Manufacturer & Part No.
	IF ASSEMBLY, A2A2 (Part No. 42107) - Continued		
R35	RESISTOR, Fixed, comp, 4700 ohms ±10%, 1/4 W	200-0472	01121 CB4721
R36	Same as R35		
R37	RESISTOR, Fixed, comp, 200 ohms ±5%, 1/4 W	341-0201	01121 CB2015
R38	Same as R37		
R39	Same as R28		
R40	Same as R25		
T1A	COIL, RF	42132-0002	
T1B	COIL, RF	42132-0003	
Y1	CRYSTAL	42145	
	CAVITY KIT ASSEMBLY, A3 (Part No. 42256-0250 or 42257-0250)		
	Note The detail parts of this assembly are nonprocurable.		
	CODER-TRANSMITTER ASSEMBLY, A4 (Part No. 42105-0859)		
C1	CAPACITOR, Fixed, ceramic, 150 pF ±10%, 200 Vdc	28448-0151	72982 X5F
C2	CAPACITOR, Fixed, mica, 1300 pF ±5%, 500 Vdc	40632-5132	72699 SRDM19
C3	CAPACITOR, Fixed, mica, 300 pF ±5%, 500 Vdc	30956-0301	72136 CM05
C4	CAPACITOR, Fixed, ceramic 22 pF ±5%, 500 Vdc	27696-0220	
C5	CAPACITOR, Fixed, mica, 2000 pF ±5%, 500 Vdc	40632-5202	72699 SRDM19
C6	Same as C3		
C7	Same as C4		
C8	CAPACITOR, Fixed, plastic, 0.0047 MFD ±10%, 250 Vdc	36054-1472	73445 C280AE
C9	CAPACITOR, Fixed, mica, 270 pF ±5%, 500 Vdc	30956-0271	72136 CM05
C10	CAPACITOR, Fixed, ceramic, 15 pF ±5%, 500 Vdc	27696-0150	
C11	CAPACITOR, Fixed, mica, 220 pF ±5%, 500 Vdc	30956-0221	72136 CM05
C12	Same as C8		
C13	Same as C2		
C14	Same as C3		
C15	Same as C4		
C16	Same as C4		
C17	Same as C6		
C18	Same as C4		
C19	CAPACITOR, Fixed, plastic, 0.0022 MFD ±10%, 250 Vdc	36054-1222	73445 C280AE
C20	CAPACITOR, Fixed, ceramic, 3.3 pF ±5%, 500 Vdc	27696-9331	
C21	CAPACITOR, Variable, ceramic, 9.35 pF, 350 Vdc	34231-0008	72982 538
C22	CAPACITOR, Fixed, ceramic, 10 pF ±10%, 500 Vdc	42627	72982 301
C23	CAPACITOR, Fixed, mica, 100 pF ±2%, 500 Vdc	30733-0101	
C24	CAPACITOR, Fixed, plastic, 1000 pF ±10%, 250 Vdc	36054-1102	73445 C280AE
C25	Same as C19		
C26	CAPACITOR, Fixed, ceramic, 100 pF ±10%, 200 Vdc	28448-0101	72982 X5F
C27	CAPACITOR, Fixed, ceramic, 220 pF ±10%, 200 Vdc	28448-0221	72982 X5F
C28	Same as C8		

RT-859A RECEIVER-TRANSMITTER PARTS LIST - Continued

Reference Des.	Description	Part No.	Manufacturer & Part No.
	CODER-TRANSMITTER ASSEMBLY, A4 (Part No. 42105-0859) - Continued		
C29	CAPACITOR, Fixed, tantalum, 0.47 MFD ±10%, 35 Vdc	42238-7474	56289 198D
C30	CAPACITOR, Fixed, ceramic, 330 pF ±10%, 200 Vdc	28448-0331	72982 X5F
C31	Same as C9		
C32	CAPACITOR, Fixed, ceramic, 1000 pF ±10%, 200 Vdc	28448-0102	72982 X5F
C33	CAPACITOR, Fixed, ceramic, 220 pF ±10%, 200 Vdc	28448-0221	72982 X5F
C34	Same as C30		
C35	CAPACITOR, Fixed, plastic, 0.22 MFD ±10%, 250 Vdc	36054-1224	73445 C280AE
C36	CAPACITOR, Fixed, tantalum, 39 MFD ±10%, 10 Vdc	42238-3306	56289 198D
C37	CAPACITOR, Fixed, ceramic, 0.05 MFD -20 +80%, 25 Vdc	31456-9503	72982 Y5U
C38	(Not Used)		
C39	(Not Used)		
C40	Same as C37		
C41	CAPACITOR, Fixed, ceramic, 0.01 MFD -20 +80%, 25 Vdc	31476-9103	72982 X5V
C42	Same as C41		
C43	CAPACITOR, Fixed, plastic, 0.018 MFD ±10%, 250 Vdc	36054-1183	73445 C280AE
C44	CAPACITOR, Fixed, mica, 1200 pF ±5%, 500 Vdc	40632-5122	72699 SRDM19
C45	Same as C19		
C46	CAPACITOR, Fixed, mica, 110 pF ±5%, 500 Vdc	30956-0111	72136 CM05
C47	CAPACITOR, Fixed, mica, 36 pF ±5%, 500 Vdc	32134-0360	
C48	CAPACITOR, Fixed, mica, 27 pF ±5%, 500 Vdc	32134-0270	
C49	Same as C37		
C50	CAPACITOR, Fixed, electrolytic, 100 MFD -10 +100%, 40 Vdc	38269-4007	73445 ET101X040A6
C51	CAPACITOR, Ceramic, disc, 0.1 MFD -20 +80%, 12 Vdc	29293-9102	
C52	Same as C51		
C53	CAPACITOR, Fixed, tantalum, 47 MFD ±10%, 6 Vdc	42238-2476	56289 198D
C54	Same as C51		
C55	Same as C36		
C56	Same as C37		
C57	(Not Used)		
C58	Same as C36		
C59	CAPACITOR, Fixed, plastic, 0.047 MFD ±10%, 200 Vdc	36054-1473	73445 C280AE
C60	Same as C36		
C61	CAPACITOR, Fixed, mylar, 0.015 MFD ±10%, 1600 Vdc	42221-9153	56289 220P153916B3
C62	CAPACITOR, Fixed, mylar, 0.033 MFD ±10%, 1600 Vdc	42221-9333	56289 220P3339a6B3
C63	(Not Used)		
C64	(Not Used)		
C65	(Not Used)		
C66	(Not Used)		
C67	Same as C51		
C68	Same as C37		
C69	(Not Used)		
C70	(Not Used)		
C71	Same as C51		
C72	(Not Used)		
C73	CAPACITOR, Fixed, ceramic, 0.01 MFD -20 +80%, 25 Vdc	31456-9103	72982 Y5U
C74	CAPACITOR, Fixed, ceramic, 0.022 MFD ±20%, 100 Vdc	95188-9223	14655 Type H
C75	Same as C74		
CR1	SEMICONDUCTOR DEVICE, Diode	38336	93332 D-6762
CR2-CR9	Same as CR1		
CR10	DIODE, Zener	35829-9511	81483 1N751
CR11	Same as CR1		
CR12	SEMICONDUCTOR DEVICE, Diode	42230	
CR13	Same as CR12		

RT-859A RECEIVER-TRANSMITTER PARTS LIST - Continued

Reference Des.	Description	Part No.	Manufacturer & Part No.
CODER-TRANSMITTER ASSEMBLY, A4 (Part No. 42105-0859) - Continued			
CR14	DIODE	31293	
CR15	Same as CR1		
CR16	DIODE, Silicon	35095-0500	13327 SOD100H
DS1	LAMP, Incandescent	31481-0140	
DS2-DS3	Same as DS1		
F1	FUSE, Cartridge	32974-2000	
J1	CONNECTOR, Electrical	42104-0023	00779 1-582390-2
L1	CHOKE, RF	42142	
L2	CHOKE, RF	34614-0101	
L3	CHOKE, RF	34614-0152	
L4	COIL, RF	42234-0000	
L5	CHOKE, RF	31193-9471	
Q1	TRANSISTOR	41123-0022	17803 2N5134
Q2-Q10	Same as Q1		
Q11	TRANSISTOR	41123-0024	17803 2N5139
Q12	TRANSISTOR	41123-0021	17803 2N5133
Q13	Same as Q11		
Q14	Same as Q1		
Q15	Same as Q11		
Q16	Same as Q12		
Q17	TRANSISTOR	35854-0000	07263 2N3638
Q18	TRANSISTOR	38401-4916	07263 2N4916
Q19	TRANSISTOR	38262-2405	79089 2N2405
Q20	Same as Q1		
Q21	(Not Used)		
Q22	TRANSISTOR	41123-0027	03508 2N5308
Q23	Same as Q1		
Q24	TRANSISTOR	41123-0025	17803 2N3567
Q25	Same as Q11		
Q26	TRANSISTOR	41123-0020	17803 2N5128
Q27	TRANSISTOR	38294-4870	04713 2N4870
Q28	Same as Q1		
Q29	TRANSISTOR	39905-5494	79089 2N5494
Q30	TRANSISTOR	41123-0023	17803 2N5138
Q31	TRANSISTOR	41123-0026	03508 2N5172
Q32	Same as Q31		
Q33	TRANSISTOR	41123-0029	79089 2N6109
Q34	Same as Q33		
Q35	Same as Q30		
Q36	TRANSISTOR	41123-0021	79089 2N5133
R1	RESISTOR, Fixed, comp, 150 ohms ±10%, 1/4 W	200-0151	01121 CB1511
R2	RESISTOR, Fixed, metal film, 14,300 ohms ±1%, 1/4 W	39319-1434	75042 CEA
R3	RESISTOR, Fixed, comp, 1000 ohms ±10%, 1/4 W	200-0102	01121 CB1021

RT-859A RECEIVER-TRANSMITTER PARTS LIST - Continued

Reference Des.	Description	Part No.	Manufacturer & Part No.
	CODER-TRANSMITTER ASSEMBLY, A4 (Part No. 42105-0859) - Continued		
R4	RESISTOR, Variable, 1000 ohms ±20%, 1/2 W	40878-0102	80294 3359P
R5	RESISTOR, Fixed, comp, 3300 ohms ±10%, 1/4 W	200-0332	01121 CB3321
R6	Same as R1		
R7	RESISTOR, Fixed, comp, 100,000 ohms ±10%, 1/4 W	200-0104	01121 CB1041
R8	RESISTOR, Fixed, comp, 680 ohms ±10%, 1/4 W	200-0681	01121 CB6811
R9	Same as R2		
R10	RESISTOR, Fixed, comp, 1000 ohms ±10%, 1/4 W	200-0102	01121 CB1021
R11	RESISTOR, Variable, 200 ohms ±20%, 1/2 W	40878-0221	80294 3359P
R12	Same as R5		
R13	Same as R1		
R14	Same as R7		
R15	RESISTOR, Fixed, comp, 2200 ohms ±10%, 1/4 W	200-0222	01121 CB2221
R16	Same as R15		
R17	RESISTOR, Fixed, comp, 1800 ohms ±10%, 1/4 W	200-0182	01121 CB1821
R18	Same as R1		
R19	Same as R2		
R20	Same as R3		
R21	Same as R4		
R22	Same as R5		
R23	Same as R1		
R24	Same as R7		
R25	Same as R17		
R26	Same as R1		
R27	Same as R2		
R28	Same as R3		
R29	Same as R4		
R30	Same as R5		
R31	Same as R1		
R32	Same as R7		
R33	Same as R8		
R34	Same as R2		
R35	Same as R3		
R36	Same as R11		
R37	Same as R5		
R38	Same as R1		
R39	Same as R7		
R40	RESISTOR, Fixed, comp, 820 ohms ±5%, 1/4 W	341-0821	01121 CB8215
R41	RESISTOR, Fixed, comp, 3900 ohms ±5%, 1/4 W	341-0392	01121 CB3925
R42	Same as R41		
R43	Same as R41		
R44	Same as R41		
R45	Same as R41		
R46	RESISTOR, Fixed, comp, 18,000 ohms ±10%, 1/4 W	200-0183	01121 CB1831
R47	RESISTOR, Fixed, comp, 330 ohms ±10%, 1/2 W	344-0331	01121 EB3311
R48	RESISTOR, Fixed, comp, 560 ohms ±10%, 1/4 W	200-0561	01121 CB5611
R49	RESISTOR, Fixed, comp, 2700 ohms ±10%, 1/4 W	200-0272	01121 CB2721
R50	Same as R48		
R51	Same as R8		
R52	Same as R3		
R53	Same as R3		
R54	RESISTOR, Fixed, comp, 4700 ohms ±10%, 1/4 W	200-0472	01121 CB4721
R55	RESISTOR, Fixed, comp, 390 ohms ±10%, 1/4 W	200-0391	01121 CB3911
R56	Same as R8		
R57	RESISTOR, Variable, 10,000 ohms ±20%, 1/2 W	40878-0103	80294 3359P
R58	RESISTOR, Fixed, comp, 12,000 ohms ±10%, 1/4 W	200-0123	01121 CB1231

RT-859A RECEIVER-TRANSMITTER PARTS LIST - Continued

Reference Des.	Description	Part No.	Manufacturer & Part No.
	CODER-TRANSMITTER ASSEMBLY, A4 (Part No. 42105-0859) - Continued		
R59	RESISTOR, Fixed, comp, 8200 ohms ±10%, 1/4 W	200-0822	01121 CB8221
R60	Same as R17		
R61	RESISTOR, Fixed, comp, 27 ohms ±10%, 1/4 W	200-0270	01121 CB2701
R62	Same as R8		
R63	RESISTOR, Fixed, comp, 330 ohms ±10%, 1/4 W	200-0331	01121 CB3311
R64	Same as R63		
R65	RESISTOR, Fixed, metal film, 3740 ohms ±1%, 1/4 W	35319-3743	75042 CEA
R66	RESISTOR, Variable, 2000 ohms ±20%, 1/2 W	40878-0222	80294 3359P
R67	Same as R48		
R68	RESISTOR, Fixed, comp, 470 ohms ±10%, 1/4 W	200-0471	01121 CB4711
R69	RESISTOR, Fixed, comp, 27 ohms ±10%, 1/2 W	344-0270	01121 EB2701
R70	(Not Used)		
R71	(Not Used)		
R72	RESISTOR, Fixed, comp, 56 ohms ±10%, 1/4 W	200-0560	01121 CB5601
R73	Same as R68		
R74	RESISTOR, Fixed, comp, 3.9 ohms ±10%, 1/2 W	344-9391	01121 EB39G1
R75	Same as R68		
R76	RESISTOR, Fixed, comp, 47 ohms ±10%, 1/4 W	200-0470	01121 CB4701
R77	RESISTOR, Fixed, comp, 10,000 ohms ±10%, 1/4 W	200-0103	01121 CB1031
R78	Same as R54		
R79	Same as R58		
R80	RESISTOR, Fixed, comp, 56 ohms ±10%, 1/2 W	344-0560	01121 EB5601
R81	(Not Used)		
R82	Same as R3		
R83	RESISTOR, Fixed, comp, 390 ohms ±10%, 1/2 W	344-0390	01121 CB3901
R84	Same as R70		
R85	RESISTOR, Fixed, comp, 39 ohms ±10%, 1/4 W	200-0390	01121 CB3901
R86	Same as R63		
R87	Same as R71		
R88	RESISTOR, Fixed, comp, 180 ohms ±10%, 1/4 W	200-0181	01121 CB1811
R89	RESISTOR, Fixed, comp, 150 ohms ±10%, 1/2 W	344-0151	01121 EB1511
R90	RESISTOR, Fixed, comp, 220 ohms ±10%, 1/4 W	200-0221	01121 CB2211
R91	RESISTOR, Fixed, comp, 270 ohms ±10%, 1/4 W	200-0271	01121 CB2711
R92	Same as R11		
R93	Same as R68		
R94	Same as R68		
R95	RESISTOR, Fixed, ww, 10 ohms ±5%, 3 W	209-0100	
R96	RESISTOR, Fixed, comp, 10 ohma ±10%, 1/4 W	200-0100	01121 CB1001
R97	Same as R40		
R98	RESISTOR, Fixed, comp, 100 ohma ±5%, 1/4 W	341-0101	01121 CB1015
R99	RESISTOR, Fixed, comp, 75 ohma ±5%, 1/4 W	341-0750	01121 CB7505
R100	RESISTOR, Fixed, ww, 20 ohms ±5%, 3 W	209-0200	
R101	Same as R76		
R102	RESISTOR, Fixed, comp, 3,300,000 ohms ±10%, 1/2 W	344-0335	01121 EB3351
R103	Same as R102		
R104	Same as R3		
R105	Same as R77		
R106	Same as R3		
R107	Same as R63		
R108	Same as R5		
R109	Same as R3		
R110	Same as R7		
R111	Same as R3		
R112	Same as R76		
R113	Same as R1		

RT-859A RECEIVER-TRANSMITTER PARTS LIST - Continued

Reference Des.	Description	Part No.	Manufacturer & Part No.
	CODER-TRANSMITTER ASSEMBLY, A4 (Part No. 42105-0859) - Continued		
R114	Same as R63		
R115	Same as R15		
R116	RESISTOR, Fixed, comp, 47,000 ohms ±10%, 1/4 W	200-0473	01121 CB4731
R117	RESISTOR, Fixed, comp, 820 ohms ±10%, 1/4 W	200-0821	01121 CB8211
R118	Same as R63		
R119	RESISTOR, Fixed, comp, 33,000 ohms ±10%, 1/4 W	200-0333	01121 CB3331
R120	RESISTOR, Fixed, comp, 180,000 ohms ±10%, 1/4 W	200-0184	01121 CB1841
R121	(Not Used)		
R122	(Not Used)		
R123	Same as R76		
R124	Same as R63		
R125	RESISTOR, Fixed, comp, 18 ohms ±10%, 1 W	342-0180	01121 GB1801
R126	RESISTOR, Fixed, comp, 220 ohms ±10%, 1/2 W	344-0221	01121 EB2211
R127	RESISTOR, Fixed, comp, 10,000 ohms ±10%, 1/4 W	200-0103	01121 CB1031
S1	PRINTED CIRCUIT SWITCH	41452-0001	
S2	PRINTED CIRCUIT SWITCH	41452-0002	
T1	TRANSFORMER, Power supply	41454	89870 BTC10107
U1	INTEGRATED CIRCUIT	42237-0946	07263 U9A994659X
U2	INTEGRATED CIRCUIT	36946-0000	01295 SN7400N
U3	INTEGRATED CIRCUIT	42236-9815	04713 MC9815P
U4	INTEGRATED CIRCUIT	42236-0824	04713 MC824P
U5	INTEGRATED CIRCUIT	42237-0949	07263 U9A994959X
U6	Same as U2		
U7	INTEGRATED CIRCUIT	42237-0936	07263 U9A993659X
U8	Same as U1		
U9	INTEGRATED CIRCUIT	42237-0932	07263 U9A993259X
U10	INTEGRATED CIRCUIT	42237-9093	07263 U9Z909359X
U11-U14	Same as U10		
U15-U21	INTEGRATED CIRCUIT	42237-0930	07263 U9A993059X
U22-U23	Same as U1		
U24	NETWORK, Resistor	42497	
	FRONT PANEL ASSEMBLY, A5 (Part No. 42258-0002)		
DS1	LIGHT, Indicator	42231	71744 CM27-49
DS2	LAMP, Incendescent	31481-0140	
DS3	Same as DS2		
DS4	LAMP, Miniature (Part of switch and lamp assembly P/N 42473)	42465	71744 CM8-444
S1	SWITCH, Pushbutton	42146-0001	
S2	SWITCH, Pushbutton	42146-0002	
S3	SWITCH AND LAMP ASSEMBLY	42973	
V1	PHOTOELECTRIC CELL	38149-0000	

RT-859A RECEIVER-TRANSMITTER PARTS LIST - Continued

Reference Des.	Description	Part No.	Manufacturer & Part No.
	CHASSIS ASSEMBLY, A6 (No Number)		
R1	RESISTOR, Fixed, ww, 50 ohms, 15 W	42490	91637 HLM15-10Z
VR1	SEMICONDUCTOR DEVICE, Diode, zener, type 1N5337B	42489	

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